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We Don't Train in Vain: A Systematic Review and Meta-Analysis of Human and Canine Caregiver Training

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Abstract

A meta-analytic review was conducted to assess the current knowledge regarding caregiver training effectiveness for human-human and human-canine dyads. The results showed that most canine-related sources (66%; n=19) were case studies reporting a decrease of learner undesired behavior when using oral instruction/advice (21%; n=6). Most of the human-related research used single-case designs (57%; n=26) reporting an increase in desired learner behavior (22%; n=10) when caregivers received multi-component training packages, including two or more approaches (17%, n=8). The meta-analysis of between-group-design studies (n=18) revealed that interventions had a large effect (Hedges' g=0.88, 95%CI [0.68-1.07]), with packages yielding a slightly larger moderate effect (Hedges' g=0.76, 95%CI [0.60-0.91]) than oral instruction/advice alone (Hedges' g=0.74, 95%CI [0.32-1,15]). Although the shown effectiveness of caregiver training is promising, the results should be interpreted cautiously. Due to the preponderance of case studies within canine-related literature and the insufficient reporting of data across sources, only few studies could be included in the meta-analysis. Overall, more systematic and comparative research regarding the efficacy of caregivers in behavior change programs across species is needed. 174 words

Keywords: systematic-review; human-dog relationship; caregiver-training; interventions

Introduction

Of all companion animals, dogs (*Canis lupus familiaris*) have been associated with humans for the longest period (Clutton-Brock, 1995). Primary association between humans and early wolves most likely began 32,000 years ago (Thalmann *et al.*, 2013). Dogs play an astonishing range of roles in human society, including affecting social interactions, lifestyles and economics (Hart, 1995; Schöberl *et al.*, 2012; Udell & Wynne, 2008). Despite their overall positive impact on human well-being and health (Heady & Grabka, 2007; Westgarth,

Christley & Christian, 2014; Westgarth, Christian & Christley, 2015), companion dogs can – just like humans – display unwanted behaviors. These are typically behaviors that either occur too often (i.e., behavioral excesses) or not often enough (i.e., behavioral deficits – Pierce & Cheney, 2013). Behavioral issues can be categorized by their topography and owner-perceived severity, such as "undesirable behaviors" which owners find unpleasant (e.g., tail chasing or destructiveness), and "problem behaviors" which are difficult to overcome for the owners (e.g., inter- and intraspecific aggression, excessive barking, and fear and anxiety - Pirrone *et al.*, 2015). Both categories can create socially significant problems for the individuals themselves and/or their caregivers (Edwards & Poling, 2011), and may result in a breakdown of the human-dog relationship with the dog being at risk for relinquishment (Kwan & Bain, 2013; Wells & Hepper, 2000).

Yet, canine-related research only recently started to focus on the importance of caregivers for the implementation of interventions (e.g., Echterling-Savage *et al.*, 2014; Howard & DiGennaro-Reed, 2014). This is surprising on at least two respects. First, the importance and efficacy of caregivers' as interventionists are well documented in the human-related literature. For instance, Fukkink & Lont (2007) reviewed studies published from 1980 to 2005 demonstrating that specialized training improved the competencies of caregivers in general childcare skills, independent of the educational level of caregivers, and the setting of the trainings. Second, some research already pointed to the notion that caregiver education and training is protective against companion-animal relinquishment and resulting welfare implications, for instance a breakdown of the human-companion animal bond (Diesel, Brodbelt & Pfeiffer, 2010; Diesel, Pfeiffer & Brodbelt, 2008; Houpt, Honig & Reisner, 1996). However, only few studies investigated caregiver-training interventions with respect to effectiveness and reduction or prevention of companion-dog relinquishment, as Coe *et al.* (2014) have found. Their scoping review highlighted that although caregiver education was the most commonly recommended intervention, the majority of studies focused on

understanding the reasons for companion-animal relinquishment using mostly observational or survey-based methods. These findings underscore the notion that while caregiver education may be frequently recommended, it is not necessarily the most commonly applied or implemented one. Further in this vein, Coe *et al.* (2014) emphasized the need for primary research investigating the effectiveness of caregiver-training interventions on relinquishments and suggested the periodic update of respective systematic literature reviews and meta-analyses.

Correspondingly, the primary aim of the current study was to assess and compare existing literature involving caregiver training within human-canine and human-human dyads. To achieve this, effect size computations for caregiver and learner behavior change were conducted based on the different interventions used. Possible explanations for the differing effectiveness of interventions were provided, leading to further research suggestions related to canine-caregiver training. To the authors' knowledge this is the first meta-analytic review that attempted this task.

Method

A systematic literature review and meta-analysis was carried out. The systematic review included between-group designs ("group designs"), case studies, and single-case designs ("SCDs"). The meta-analytic part, however, included group designs only because most canine-human-interaction studies were based on group designs (or case studies). Group designs (e.g., randomized-controlled trials) share a set of distinctive characteristics, such as (a) recruitment of as large number of participants as is practicable; (b) often random allocation of the participants to treatments; (c) aggregation of individual data in averages and other group descriptors (i.e., between-subject averaging); and (d) drawing of inferences about populations from evidence gained from samples (Blampied, 1999; Hurtado-Parrado & Lopez-Lopez, 2015; Johnston & Pennypacker, 1993). Case studies, on the other hand, are of more

qualitative nature. They often describe in great detail the assessment and/or treatment of one or more participants by integrating all information about the case into a unified and related idea or set of ideas (Sturmey, 2009; Virues-Ortega & Moreno-Rodriguez, 2008). Further, their interest is frequently related to reporting new findings that lack replication with group designs, hence, informing about new methods, novel applications of established techniques or unpredicted effects of assessments or treatments (Virues-Ortega & Moreno-Rodriguez, 2008). By contrast, SCDs are special adaptations of interrupted time-series designs and provide a strong basis for establishing causal, or functional, inference by (a) operationally defining the dependent variable; (b) conducting baseline measurements; and (c) replicating experimental conditions (e.g., A-B-A-B) with each subject (Horner *et al.*, 2005; Kratochwill *et al.*, 2010; Pearce & Cheney, 2017). Effect size estimations of SCDs were analyzed in a different project.

Literature search and study selection process

The search procedures for relevant records followed the recommendations of Petticrew and Roberts (2006) for conducting systematic literature reviews and meta-analyses and complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati *et al.*, 2009; Moher *et al.*, 2009). A list of key search terms and phrases was systematically extracted from the full texts of ten relevant peer-reviewed papers. Due to their relevance, these records were automatically included in the final list of eligible studies. Only three out of the ten records were not retrieved during the systematic search of the databases (i.e., Butler, Sargisson & Elliffe, 2011; Clark & Boyer, 1993; Echterling-Savage *et al.*, 2014).

Literature searches were conducted by utilizing following databases: Directory of European Research Theses (DART-Europe), Education Resources Information Center (ERIC), International Bibliography of the Social Sciences (IBSS), OpenGrey, PsychINFO, PubMed, ScienceDirect, Scopus, and Web of Science.

No restrictions regarding publication dates were used. Inclusion criteria were: (a) studies constituted original research (i.e., peer-reviewed papers), conference proceedings, case studies or doctoral theses; (b) parents (i.e., the term "caregivers" is used from here on) were given advice and/or have implemented the behavioral treatments/interventions; (c) dog owners (i.e., the term "caregivers" is used from here on) were given advice and/or have implemented the behavioral treatment/interventions; (d) settings included home, clinical or any other external settings (e.g., therapy rooms, practices, dog training facilities or shelter environment); (e) caregivers were aged 18 years or older; (f) the study concerned advice and/or training given to caregivers on how to implement a behavior change program; (g) records involved either human or canine learners (e.g., Cottam *et al.*, 2008; Najdowski *et al.*, 2010); and (h) sources were published in English or German (i.e., first author's native language). The study selection process is summarized in Figure 1.

Forty-two of the relevant records had incomplete referencing information (i.e., either title, abstract or author information missing). These were evaluated during the second stage of the selection process (i.e., obtaining and screening of full texts for eligibility). For most of these articles (i.e., 36 records), full texts were obtained by exhausting following access options: (a) University's library resources (i.e., online catalogue function, contacting subject librarian, and requesting inter-library loan service); (b) searching Google® including Google® Scholar™; (c) searching online library systems of respective journals (e.g., Journal of the American Veterinary Medical Association or The Veterinary Record); (d) contacting respective authors. However, six of these 42 records had to be excluded due to inaccessibility of full texts, as neither of above strategies was successful in accessing respective records within the set time frame (i.e., November 30th 2017 to January 19th 2018).

To ensure reliability of relevance decisions, a trained research assistant (LGM) who was unaware regarding the aims of the study independently viewed 25% of the retrieved sources' abstracts based on the information provided by inclusion and exclusion criteria (i.e.,

"Screening" step – Figure 1). Studies appraised by the second reviewer were randomly selected utilizing the Microsoft® Excel application "random function" (i.e., assorting randomized numbers to each of the 856 total sources followed by randomly selecting 215 articles). Each reviewer's agreements and disagreements of the selected literature were compared, and an inter-rater agreement (i.e., IRA) score was calculated by number of agreements divided by number of agreements plus number of disagreements multiplied by 100. IRA computation yielded a 94% agreement score across both reviewers. Any disagreements were resolved by discussion.

[Please insert Figure 1 here]

Coding of studies and data extraction

For the coding process, a specially designed Microsoft® Excel™ matrix was utilized. All 66 studies were coded on following criteria: (a) reference information (i.e., title, authors, date, publication); (b) sample size; (c) description of selection of sample, i.e., demographic information and information whether human- or canine learners were participating; (d) description of undesired learner behavior; (e) methodological type (i.e., SCDs, group designs, case studies); (f) description of the intervention type; (g) procedural integrity of intervention implementation (if reported); (h) general, qualitative outcomes of experimental evaluation (i.e., positive, negative, mixed); and (i) effect sizes (e.g., Hedges' g for group designs). If effect sizes were not given in the original studies, they were computed by using data provided in the sources.

To ensure reliability of coding, a trained research assistant independently coded 17 out of 66 candidate studies (i.e., > 25%). These articles were again randomly selected by utilizing the random function, a Microsoft® Excel™ application. The Inter-coder agreement (ICA) score was determined by number of agreements divided by number of agreements plus number of disagreements multiplied by 100. This computation was done for each of the 38

variables (e.g., total population or learner undesired behavior) which yielded an ICA of 85% across both coders. Disagreements were resolved by discussion.

Meta-statistical analysis

Out of 34 studies utilizing group designs, 18 studies reported suitable data for inclusion in a meta-analysis. Given there were at least three studies allowing a comparison, data were combined across studies focusing on type of interventions, e.g., oral instruction/advice or training package (i.e., a combination of two or more training components administered concurrently or consecutively; e.g., oral instruction/advice, modeling and feedback), and respective human or canine behavior change (i.e., outcome measures). If studies provided several measures for the same outcome, the primary outcome measure was selected based on the most complete information. Studies used different study designs (i.e., independent groups or repeated measures), and various measurement instruments (e.g., direct observation or standardized questionnaires) for assessing outcomes. For further analysis, measurements were therefore either aggregated to avoid dependence in the analysis (Borenstein, Hedges, Higgins & Rothstein, 2009) or outcomes were selected based on relevance for the current research question. Three of the 18 included studies investigated either two or more intervention types (e.g., Saunders *et al.,* [2013] used oral instruction/advice and modelling) or examined the effects of different interventions on various undesired behaviors (e.g., Clark & Boyer, [1993] examined the effects of training in obedience and quality time interactions on separation-related behaviors and other undesired behaviors).

Due to the across-studies differences, it was assumed that the true effect sizes varied from study to study, hence, it seemed reasonable to apply a random-effects model to the analysis (Borenstein, Hedges, Higgins & Rothstein, 2015). Implementation of the random-effects model allowed an analysis of the presence of moderators (Higgins & Green, 2011).

Overall effect size

The Comprehensive Meta-Analysis© software Version 3.0 (Biostat, 2018) was used to analyze data and compute standardized mean differences (SMD Hedges' g). The decision for reporting Hedges' g was reached because it introduces a correction factor for bias, yielding more accurate and conservative estimates when sample sizes are small (Borenstein *et al.*, 2009). For the current analysis, Hedges' g estimates were weighted based on sample size and calculated with respect to the different study designs used. Lipsey & Wilson (2001) stated that Hedges' g can be interpreted according to following guideline: small (0.20-0.49), medium (0.50-0.79), and large (≥0.80). However, such thresholds should always be interpreted contextually and with caution as numerically minor effects may have important impacts on participants' training or welfare. Follow-up and generalization measures were discarded, only selecting those measures for effect size estimation that were immediately involved with the treatment period. To summarize, the weighted mean effect size computations were calculated for all interventions across human-canine and human-human dyads, and separate analyses were conducted for training packages (PG) and oral instruction/advice (OI).

Heterogeneity or between-study variation

Computation of heterogeneity (i.e., Q statistics, T^2 and I^2) of studies, as well as generating forest plots was conducted using the Comprehensive Meta-Analysis Software Version 3.0 (Biostat, 2018). The Q test measured the presence of heterogeneity among studies and was computed as the weighted sum of squared differences between each study effects and the pooled effect across studies (Cochran, 1954). In other words, the Q statistic gives information about whether included studies have unaccounted variance, and if specific characteristics are moderating the effect in addition to the assumption of random error (Germain *et al.*, 2018). Further, if the Q statistic yields a statistically significant ($p<0.05$) result, the included studies do not share a common effect size (Borenstein *et al.*, 2009), and that the between-study

variation cannot be accounted for by sampling error (Littell, Corcoran & Pillai, 2008). Additional to *Q,* T^2 and I^2 statistics were calculated to further quantify heterogeneity. T^2 is an estimate of variance, which provides information about the variance of effect sizes across the population of studies (Borenstein *et al.*, 2009; Borenstein, Hedges, Higgins & Rothstein, 2010). I^2 on the other hand is a method to quantify the proportion of observed variation in the estimates of treatment effect that is due to heterogeneity between studies rather than chance and is expressed in percentage of total variability (Higgins & Thomson, 2002; Neyeloff, Fuchs & Moreira, 2012). A general guide to the interpretation of I^2 is as follows (Higgins & Green, 2011): (a) I^2 values of 30% to 60% represent moderate heterogeneity; (b) 50% to 90% represent substantial heterogeneity; and (c) I^2 >75% represents considerable heterogeneity between study effects. However, I^2 should always be used and interpreted with caution and is best reported in combination with forest plots and T^2 to give the reader maximum information about heterogeneity and the true effects (Borenstein, n.d.).

Moderator analysis

The next step in the analysis was to investigate which study characteristics may have been associated with efficacy of interventions. This was achieved through the implementation of a moderator analysis. A meta-regression approach was used based on the type of characteristics available (e.g., type of study design and choice of comparison intervention - Higgins & Green, 2011). Moderator analysis through meta-regression allowed the effect of continuous (e.g., publication year), as well as categorical (e.g., intervention type) features to be investigated, and principally also allowed the effects of multiple factors to be examined simultaneously (Higgins & Green, 2011). The outcome variable was Hedges' g and the characteristics extracted were the potential effect modifiers (Higgins & Green, 2011; Keenan, 2018).

Publication bias

The term publication bias refers to the issue that studies often report desirable outcomes (e.g., statistically significant results) more readily than nonsignificant outcomes (Petticrew & Roberts, 2006). Obtaining and including published and unpublished studies irrespective of their results may at least partially address this issue (Higgins & Green, 2011; Petticrew & Roberts, 2006). Hence, the current review included grey-literature (e.g., reports produced by government agencies) databases, i.e., ERIC. Two unpublished doctoral dissertations (i.e., Mulford, 2011; Van Camp, 2005) were eligible for inclusion into the systematic review. However, both implemented SCDs and therefore were not included in the meta-analysis.

A funnel plot was produced and visually assessed to detect potential publication bias. Funnel plots are scatterplots that outline each included study according to Hedges' g and standard error (Keenan, 2018). If the sample size of studies increased, the range of effect sizes estimated by each study decreased, which lead to more precise estimates. When such results are displayed as scatter plots, the latter show an inverted funnel shape (Petticrew & Roberts, 2006). The funnel plot becomes asymmetrical and shows a gap in a bottom corner of the graph if a bias exists. The effect computed in a meta-analysis tends to overestimate the intervention effect. In other words, the more pronounced the asymmetry, the more likely that the level of bias is substantial (Higgins & Green, 2011). However, if a meta-analysis consists of a representative number of studies with large sample sizes and statistically significant studies, which are more likely to be published, the funnel plot will appear symmetrical, indicting no publication bias, irrespective of selective publication based on p-values (Keenan, 2018). Since visual inspection of funnel plots is subjective, a linear regression between the standard error of included studies and their Hedges g's (i.e., Egger's regression - Egger *et al.*, 1997) was computed. If the regression test yields statistical significance ($p<0.01$), this result also indicates asymmetry in the funnel plot. Although Egger's regression is said to have increased power to detect bias (compared to a rank correlation), results should be carefully

considered when moderate amounts of bias or meta-analyses based on small numbers of small studies are examined (Sterne, Gavaghan & Egger 2000), as is the case in this study.

Results

The characteristics of the studies included in the meta-analytic review are displayed in Table 1.

[Please insert Table 1 here]

Descriptive findings

Study characteristics

Sources included in the current literature review were retrieved from several outlets, such as databases for accessing peer-reviewed papers and repositories storing grey literature.
The systematic search yielded studies published between 1972 and 2017. Out of the 66 included studies, 96.9% (n=64) were peer-reviewed journal articles, while 3.0% (n=2) were unpublished doctoral dissertations from Universities in the USA. No other grey literature, such as book chapters, conference proceedings or government reports was eligible.

Most of the included articles were published in the Journal of Applied Behavior Analysis (28.8%, n=19), followed by the *Journal of the American Veterinary Medical Association* (11%, n=10), and the *Journal of Child and Family Studies* (9%, n=6). The remaining journals were somewhat similarly distributed across all sources, with *Research in Autism Spectrum Disorders* featuring 5% (n=3) of studies, followed by *Applied Animal Behavior Science, Behavioral Interventions, Journal of Applied Animal Welfare Science, Journal of Veterinary Behavior: Clinical Applications and Research, Prevention Science*, and *Veterinary Record* featuring 3% (n=2) of studies, each. The remaining journals, such as

Australian Veterinary Journal, Behavior Therapy, Canadian Veterinary Journal, Clinical Case Studies, Education and Treatment of Children, Family Process, Focus on Autism and Other Developmental Disabilities, Journal of Autism and Developmental Disorders, Modern Veterinary Practice, Northwest Medicine, Pediatrics, Psychologie Francaise, Research in Developmental Disabilities, and *Schweizer Archiv für Tierheilkunde* all featured 2% (n=1) of studies, respectively.

Participant characteristics

A considerable amount of variability regarding the details on participant characteristics was found across all studies. Noticeable, 21% (n=16) of all eligible studies (n=66) did not clearly state their participants' or subjects' characteristics. Among the reported characteristics were details such as ethnicity and/or socio-economic status. However, coded variables relevant for the current review included caregiver population, caregiver education, caregiver gender, learner gender/sex, and learner age. Table 2 presents participant characteristics according to study designs and broken down to canine- or human-related studies.

Canine-related findings. Out of all canine studies (n=28), 50% (n=14) of the papers did not clearly state characteristics of participants. Thirty-nine percent (n=11) of the studies included female and male caregivers; 8% (n=2) of these studies also stated caregiver education, which were either low (secondary school; n=1) or medium (under graduate; n=1). Eleven percent (n=3) of the papers consisted of female dog owners only and no level of education was provided.

Almost all canine studies (93%; n=26) reported details about the dogs' age range and sex. Except for 7% (n=2) of the studies which did not clearly state this information. Many of the papers (39%; n=11) comprised puppies and adolescent dogs (i.e., 2 to 24 months). Eighteen percent (n=5) of the studies had either adult dogs (i.e., 2 to 8 years) or

mostly puppies and adolescent dogs as their subjects. Mostly adult dogs participated in 11% (n=3) of the papers. Only 7% (n=2) of the sources did not clearly state the age or age range of the subjects. Studies comprising senior dogs (i.e., older than 8 years) or mostly senior dogs were found in only 4% (n=1) of the sources, respectively.

A quarter of the included studies (25%; n=7) consisted of neutered male dogs as subjects, while almost as many papers (21%; n=6) did not clearly specify sex and neuter status of their subjects. The rest of the included studies (54%; n=15), involved either both sexes (36%; n=10) regardless of the neuter status or comprised of only female dogs (18%; n=5), either neutered (11%; n=3) or intact (7%; n=2).

Human-related findings. Information about the gender distribution was reported in 79% (n=37) of studies. More than half (57%; n=27) of these had female caregivers (parents) participating only. In 21% (n=10) of the studies, parent gender distribution was not clearly specified. The rest of the included papers (21%; n=10) reported that male and female parents participated, with mostly females (15%; n=7), and both genders equally distributed in 6% (n=3) of the studies.

Details about caregiver education was provided in 38% (n=18) of the studies. In 21% (n=10) papers most participants had medium (i.e., undergraduate level) education, while in 17% (n=8) most participants had low-level (i.e., secondary school) education.

Eighty-three percent (n=39) of all studies comprised children aged between one and eleven years of age. Younger children classified as infants (i.e., 0 to 1 year of age) participated in 9% (n=4) of papers. The rest of the included studies (9%; n=4) was almost equally distributed. Four percent (n=2) of the studies did not clearly report the age of children, while adolescents (i.e., 12 to 18 years of age) and mostly children (i.e., 1 to 11 years of age) were found in 2% (n=1 each) of studies.

The gender distribution of children was provided in 87% (n=41) of studies, while 13% (n=6) did not report this information. In almost a third (30%, n=14) of the papers, all participating children were males, while the rest of the studies (57%; n=27) comprised male and female children (i.e., mostly male, mostly female and both).

[Please insert Table 2 here]

Intervention types and undesired behaviors

Following sections provide detailed analyses of general type of study, type of interventions and learner undesired behaviors reported by canine or human research focus.

Canine-related studies. Twenty-nine (100%) canine-related papers implemented three different types of research designs, i.e., case studies, group designs, and single case research designs distributed as 66% (n=19), 28% (n=8), and (7%, n=2) papers, respectively. Table 3 provides details.

A third (66%; n=19) of the papers utilized a case-study design. Of these, 31% (n=9) used oral instruction/advice only to inform dog owners on how to treat their dogs' undesired behaviors. The latter included stereotypic behaviors (7%; n=2), separation-related behaviors (7%; n=2); aggressive behavior (7%; n=2), fear and anxiety (7%; n=2), and one case study (3%) simply stated behavior problems. Twenty-eight percent (n=8) of the case studies used a combination of oral and written instruction/advice to enable dog owners to mitigate their dogs' fear and anxiety (14%; n=4), separation-related behaviors (7%; n=2), stereotypic-behavior (3%; n=1), and aggressive behavior (3%; n=1). One case study (3%) used oral instruction/advice and modelling, while another one (3%) implemented an intervention

package to teach respective dog owners to train their dogs' hyperactivity and separation-related behaviors, respectively.

Twenty-eight percent (n=8) of canine-related studies implemented group designs. Out of these group studies, 7% (n=2) used a package to inform owners on the treatment of separation-related behaviors (3%; n=1) or fear and anxiety (3%; n=1). A combination of oral and written instruction/advice was used by 7% (n=2) of respective studies to advice owners on treating separation-related behaviors (7%; n=2). Three percent (n=1) of the papers instructed owners in obedience training and quality time to mitigate either separation-related behaviors (3%; n=1) or general behavior problems (3%, n=1). Written instruction/advice only was used by one paper (3%) to provide owners with information on how to train separation-related behaviors (3%; n=1). Oral instruction/advice only was implemented by one paper (3%) without clearly stating the undesired behaviors of participating dogs (3%; n=1).

SCDs were represented in the lowest count of studies. Only two papers or 7% used this type of research design and both papers implemented an intervention package to teach owners how to mitigate their dogs' separation-related behaviors (3%; n=1) or aggressive behaviors (3%; n=1).

[Please insert Table 3 here]

Human-related findings. Out of all 46 (100%) human-related studies, 57% (n=26) implemented SCDs, 39% (n=18) utilized group designs, while only 4% (n=2) were designed as case studies. Table 4 displays this information.

Across the single SCDs, a large variation of caregiver (parent) training strategies was found. Most of these papers used an intervention package (37%; n=17) for training caregivers to treat undesired behaviors of children. Out of the studies that implemented a package, 7% (n=3) dealt either with undesired behaviors during mealtimes or language delays. Four

percent (n=2) of the studies utilizing a package taught parents to intervene with either behavior problems of some sort, non-compliance and oppositional behavior, language/communication and motor skill deficits, or did not clearly state the target behavior. Oppositional behavior, behavioral deficits, and autism spectrum disorder and language delays were found in only 2% (n=1) of the papers utilizing a package approach. The rest of the SCD parent-training interventions (14%, n=7) mainly consisted of combinations of two or more approaches (e.g., written instruction/advice, video modelling, feedback and modelling), designed to treat a range of undesired behaviors, such as deficits in language, social interactions and academic skills distributed with 2% (n=1) within each intervention type. Two studies (2%; n=1) did not report the undesired behaviors displayed by respective children.

Group designs followed single SCDs by contributing 39% (n=18) of papers to all eligible records. Again, intervention packages comprised the majority of group design studies (35%; n=16). Thirteen percent (n=16) of these studies did not clearly state the type of undesired behavior, 7% (n=3) of the papers just generally stated behavior problems. However, 4% (n=2) of studies reported the undesired behaviors as either being related to autism spectrum disorder and language delays or oppositional behavior. One study (2%) each dealt with inattentive and hyperactive symptoms, deficits in language, social interaction and academic skills, and fear and anxiety. The rest of the group-design records consisted of studies using a combination of caregiver-training approaches, i.e., oral instruction/advice plus modelling (2%; n=1) or package plus written instruction/advice plus oral instruction/advice (2%; n=1). Both studies did not report the target behaviors of their interventions.

Only 4% (n=2) of human-related papers were case studies and both implemented combinations of various caregiver-training approaches. One case study dealt with behavioral deficits by teaching parents using oral instruction/advice plus modelling plus feedback. The second case study implemented an intervention package but unfortunately did not further state the type of undesired behavior the treatment was designed for.

[Please insert Table 4 here]

Qualitative caregiver-training outcomes

Across all designs, qualitative findings of caregiver training could be either "positive" (i.e., clear improvement in caregiver behavior after training), "mixed" (i.e., improvements were reported for some caregivers but was not seen in all), "negative" (i.e., decline in caregiver behavior was detected) or "not clearly stated" as indicated by the authors of eligible studies. Following sections report respective data in more detail.

Canine-related findings. Of the eligible case studies (66%; n=19), the majority (45%; n=13) did not clearly report the outcomes of the caregiver intervention. Oral instruction only, a combination of oral plus written instruction/advice, and a training package were used in 24% (n=7), 17% (n=5), and 3% (n=1) of the cases, respectively.

Most of the group designs (21%; n=6) did not clearly state the outcome of the training intervention, while two studies reported mixed (3%; n=1) or positive (3%; n=1) outcomes. The interventions used were either a package (7%; n=2), oral plus written instruction/advice (7%; n=2) or instructed the owners on obedience training or quality time (3%; n=1).

Seven percent (n=2) of the studies were SCDs implementing an intervention package, either resulting in a positive outcome or not clearly stating it (3%; n=1 each).
Table 5 displays these findings in detail.

[Please insert Table 5 here]

Human-related findings. Forty-six percent (n=21) of SCDs showed positive caregiver-training outcomes. Of those positive-outcome studies, 30% (n=14) implemented an intervention package, while the rest of the caregiver training strategies were found only once (2%; n=1) among each of the studies (Table 6).

Four percent of the studies (n=2) did not clearly state the outcomes, and distribution of written instruction/advice and intervention package was 2% (n=1), respectively.

Among the group designs (39%; n=18), 28% (n=13) showed positive outcomes, with 24% (n=11) using an intervention package, while oral instruction/advice plus modelling and package plus written instruction/advice plus oral instruction/advice were implemented in only 2% (n=1) of the studies.

Both case studies (4%) resulted in positive caregiver-training outcomes, with one implementing oral instruction/advice plus modelling plus feedback, and the second one using an intervention package.

Table 6 displays these findings in detail.

[Please insert Table 6 here]

Learner outcomes

Unlike above section about caregiver training outcome, this section is concerned with the intervention outcomes for respective learners. This means that learner behavior change was qualitatively coded as either increase desired behavior, decrease undesired behavior, increase undesired behavior, decrease desired behavior or mixed, depending on how study authors reported their findings. Learner outcomes were analyzed according to type of research design and type of interventions which were used to teach behavior change strategies to caregivers.

Canine-related findings. Table 7 displays learner outcomes of all included canine-related studies. Case studies represented the majority of study designs (66%, n=19), with 31% (n=9) of them reporting a decrease of learner undesired behaviors when utilizing either oral instruction/advice only (21%; n=6), oral plus written instruction/advice (7%; n=2), and oral instruction/advice plus modelling (3%; n=1). Mixed learner outcomes were found in 24% (n=7) of the case studies. Latter implemented either oral plus written instruction/advice (17%;

n=5) or oral instruction/advice only (7%; n=2). An increase in the dogs' desired behavior was found in 10% (n=3) of the case studies. Three percent (n=1) used either oral instruction/advice only, oral plus written instruction/advice or an intervention package.

Out of 28% (n=8) group design studies, the majority (21%; n=6) reported a decrease in the dogs' undesired behaviors. Seven percent (n=2) of these studies used intervention packages or instructed owners in obedience training plus quality time, respectively. Seven percent (n=2) of group design that used either oral plus written instruction/advice (3%; n=1) or oral instruction/advice only yielded mixed learner outcomes.

Both SCDs (7%) implemented intervention packages to train participating dog owners and both reported a decrease in undesired canine behavior.

[Please insert Table 7 here]

Human-related findings. Within the large group of SCDs (57%; n=26), all coded learner outcomes could be found. An increase in desired learner behavior was detected in 22% (n=10) of the studies, with intervention package, a combination of modelling plus package, and oral instruction/advice plus package distributed with 17% (n=8), 2% (n=1), and 2% (n=1), respectively. Fifteen percent (n=7) of SCDs resulted in a decrease of undesired learner behavior when parents were trained utilizing either an intervention package (9%, n=4), a combination of written instruction/advice plus video modelling plus feedback plus modelling (2%; n=1), feedback only (2%; n=1), or written instruction/advice only (2%; n=1). Mixed learner outcomes were found in three studies (7%), of which two (4%) implemented an intervention package, while the other one (2%) combined a package plus feedback to train parents. The last outcome variable coded within SCDs is increase of undesired behavior, which was reported in only one study (2%), which also used an intervention package.

The majority of group designs did not clearly state the learner outcome (15%; n=7). Of those inconclusive outcomes, 11% (n=5) implemented an intervention package to teach

parents how to mitigate undesired behaviors of their children, 2% (n=1) used a combination of oral instruction/advice plus modelling, and another 2% (n=1) implemented a package plus written instruction/advice plus oral instruction/advice. Thirteen percent (n=6) of group design studies reported a decrease in learner undesired behavior and all of them used an intervention package (13%; n=6). The latter was also utilized in 7% (n=3) of studies that reported an increase in desired learner behaviors, and in 4% (n=2) of studies that found mixed learner outcomes.

Out of the two case studies (4%), one did not clearly state the outcome for respective learner when utilizing an intervention package for caregiver training. The second case study reported an increase in learner desired behavior when using a combination of oral instruction/advice plus modelling plus feedback. Table 8 shows learner outcomes of all included human-related studies.

[Please insert Table 8 here]

Meta-statistical findings

Only group designs were considered for quantitative analysis. Eighteen out of 34 studies reported suitable data to be included in effect size calculations (included studies are highlighted in bold in Table 1), five of which were canine-related studies. Sixteen studies did not provide sufficient data for the meta-analysis.

Meta-analysis results

Six types of interventions (i.e., package, oral instruction/advice, written instruction/advice, modelling, quality time, and instruction in obedience) were used to assess the behavior change outcomes of caregivers and their respective learners. However, only package (n=12) and oral instruction/advice (n=4) were used in more than three studies. Thus, here we only

analyze findings on package and oral instruction/advice and offer a summary of all effect size computations across interventions (Figures 2 to 5).

Most of the studies (n=12) implemented training packages (Figure 2) demonstrating a medium summary effect size (Hedges' g=0.76, 95% CI [0.60-0.91], p=0.00).

[Please insert Figure 2 here]

About a quarter of the studies (n=4) applied oral instruction/advice only which also yielded a medium summary effect size (Hedges' g=0.74, 95% CI [0.32-1,15], p=0.00; Figure 3). Although both intervention types emerged with a moderate summary effect size (i.e., 0.50-0.79), the implementation of packages resulted in a slightly larger effect than using oral instruction/advice only (i.e., Hedges g's 0.76 vs. 0.74).

[Please insert Figure 3 here]

When examining effect sizes across all studies (Figure 4), more than half of them (n=10) showed intervention effects of Hedges' g >1.0 (range 1.03-1.76). The summary effect size across all studies and intervention types was 0.88 (95% CI [0.68-1.07, p=0.00) pointing to an overall large effect of examined studies and respective interventions.

[Please insert Figure 4 here]

Assessment of heterogeneity

After testing for heterogeneity among the 18 studies, results suggest that variability was larger than could be explained by sampling error (Q=114.76 [df=17], p<0.001, T^2=0.13). In other words, this means that the included studies do not share a common effect size. As an additional measure which gives a proportion of heterogeneity, I^2 was calculated (I^2=85%). A

generally accepted guideline is that an I^2 of >75% means considerable variance between study effects (Higgins & Green, 2011).

Moderator analysis

Although the number of studies was small (n=18), which is thought to be a limitation factor for conducting these statistical analyses (Borenstein *et al.*, 2009), meta-regressions were computed for all interventions and for variables that seemed associated with efficacy (i.e., study design, learner species and age, year of publication, and study duration). Out of these six variables four yielded statistically significant results (Table 9).

The variable learner species had a statistically significant effect on the studies' efficacy (p<0,05), namely, those studies having companion dogs as learners showed a larger effect than studies involving human learners (Figure 5a). Similarly, the variable learner age was also statistically significantly associated with larger effect sizes of studies involving adolescent and adult dogs (p<0.05; Figure 5b). Figure 5c displays a regression line, which was thought to better report respective data. While the number of studies importantly increased from 2005 onwards, efficacy of studies significantly decreased with progression of time (p<0.05; Figure 5c). Duration of the training interventions was also statistically significantly influencing effectiveness (p<0.05; Figure 5d). Results showed that interventions of longer duration (i.e., larger six months) were less effective than treatments that lasted between three and six months.

[Please insert Table 9 here]

[Please insert Figure 5 here]

Publication bias

A funnel plot was generated to visually analyze the presence of publication bias among the included studies (Figure 6). The funnel plot appeared asymmetrical, which indicated the presence of publication bias. To test this assumption, a linear regression between the standard error of the included studies and the Hedges' g (i.e., Eggers regression; Egger *et al.*, 1997) was conducted. Egger's regression method (Egger *et al.*, 1997) yielded a statistically significant (p<0.01) result, confirming the presence of publication bias and other small-study effects.

[Please insert Figure 6 here]

Discussion

While the effectiveness of caregiver training was repeatedly shown in educational, psychological, and behavior-analytic research, including meta-analyses (e.g., Bearss, Burrell, Stewart & Scahill 2015; Crone & Mehta, 2016; Fukkink & Lont, 2007; Ilg *et al.*, 2018), the topic did not yet attract wide attention within the animal behavior research community (Coe *et al.*, 2014; Howard & DiGennaro-Reed, 2014). This is surprising as similarities between owner-dog and parent-child relationships (Hare & Tomasello, 2005; Prato-Previde *et al.*, 2003; Prato-Previde & Valsecchi, 2014; Tomasello & Kaminski, 2009; Topal, Miklósi, Csányi & Dóka, 1998; van Herwijnen *et al.*, 2018) are well-established, and many sources rely on dog owners to follow the animal behaviorists' instructions to implement the interventions accordingly (e.g., Butler *et al.*, 2011; Echterling-Savage *et al.*, 2014). In this vein, previous studies suggested that training caregivers to implement interventions with integrity may benefit treatment outcomes (e.g., Belfiore *et al.*, 2008; Fryling *et al.*, 2012). Therefore, this review aimed at examining the current situation of the literature from an interdisciplinary perspective across species.

Systematic review

This review found that human-related studies were mostly located within SCDs, while canine-related studies were mainly found as case studies. The latter was also remarked by Butler *et al.* (2011), which hints to the need for individual assessment and treatment of unwanted canine behaviors by practitioners. Case studies and SCDs emphasize this individuality of treatments of canine behavior problems, however, case studies lack the systematic and data-driven approach of SCDs. The second most used designs across species were group designs. One reason why only few group designs were found among eligible canine-related studies may lie in their feasibility with behavioral interventions. For instance, to achieve a strong research design, untreated control groups or other comparison groups (i.e., "treatment as usual") are implemented. This practice, however, may lead to ethical implications due to withholding potentially much needed treatment for participants (Kimmel, 2007).

Among the different study designs and across species, following teaching approaches were found: (a) packages (i.e., concurrent or consecutive implementation of two or more interventions); (b) oral instruction/advice; (c) written instruction/advice; (d) modelling; (e) feedback; (f) video modelling; (g) instructions in obedience training; (h) quality time; and (i) modelling plus role play.

Out of all interventions, packages were the most widely used approaches for human-related studies, while canine-related studies more frequently implemented oral instruction/advice. Packages comprised any of the identified interventions above but could also include otherwise unidentified components, i.e., reading assignments or counterconditioning. For the human-related SCDs and group designs, packages yielded mostly positive outcomes for caregiver and learner behavior change, however, packages were also found in studies with mixed and not clearly stated outcomes. The situation for canine-related studies was shown to be different. Packages were mostly found in not clearly stated classifications of case studies, group designs and SCDs for both caregiver and learner

outcomes. The latter may be linked to the systematic approach of SCDs on caregiver training which underscores the need for testing the suitability efficacy of various teaching strategies (i.e., modelling and/or feedback) with dog owners.

The finding that most canine-related interventions comprised oral instruction/advice only yielding inconclusive caregiver and learner outcomes may further the notion that oral instruction/advice is not sufficient to teach owners the necessary skills to train their dogs. This suggestion may be further backed up by the finding that parent-training packages yielded almost consistently positive outcomes. The meta-analysis attempted to test these expectations.

Meta-analysis

The current meta-analysis investigated the effectiveness of studies using group designs only. The decision to focus on group designs was reached because SMDs have a longer tradition and are therefore more readily computable and interpretable (Hedges, Pustejovsky & Shadish, 2012).

Overall, Summary effects showed that training caregivers was effective in changing the undesired behaviors of learners, irrespective of the learner's species.

Both packages and oral instruction/advice produced similar moderate effects. Although interventions classified as packages yielded a slightly larger effect, not all packages were equally effective. Differences between measures used to assess outcomes may have contributed to wide-ranging effect sizes (e.g., Hedges g's ranged from 0.189 to 3.120 across outcome measures - Pelham, Schnedler, Bologna & Contreras, 1980). Some studies yielded close to null effects, while one study even showed a negative effect (i.e., the intervention had undesired effects). Two distinct notions may at least partially explain these findings. First, considering methodological characteristics of the studies, the testing instruments (i.e., measures) may have been too crude or too remote from the interventions to reliably assess training effects. This may be especially true for studies that heavily relied on questionnaires

for outcome evaluation. Questionnaires are known to involve a degree of subjectivity and hence are prone to biases (Choi & Pak, 2005; Duffy, Hsu & Serpell, 2008) which may have contributed to some of the effect size outliers on both sides. While including studies into the review that used questionnaires does not constitute a problem, Petticrew & Roberts (2006) recommend avoiding questionnaires that have not previously been useful in similar reviews. Therefore, such studies were included in the current analysis as excluding these types of sources may have introduced bias into the findings, as it is practically impossible to eliminate all biases using survey methods (Nederhof, 1985). Additionally, studies that implemented packages generally mentioned the components in their method sections but reported the findings as overall treatment outcomes without investigating and specifying which components of the intervention package may have been the most effective ones. This lack of information could also have contributed to the variation in effect sizes (Bear & Nietzel, 1991).

Second, conceptual explanations for these findings should also be considered. To the authors' knowledge this is the first time that a comparison of the effectiveness of canine-related and human-related training interventions has been attempted. Hence, it is important to underscore the commonalities of the possible communicative processes involved as dogs and humans evolved together and formed a special relationship (Prato-Previde, 2014). However, just like humans, dogs can also develop problematic behaviors. In such cases, dog owners often seek the help of certified animal behaviorists who typically develop individually tailored interventions. The latter are based on similar conceptual frameworks and techniques (e.g., reinforcement and shaping) as for human learners (Gray & Diller, 2017). Whether the necessary techniques and information are conveyed to the owner by oral or written instructions, feedback (i.e., descriptions of performance that may increase one aspect of the caregivers behavior, while decreasing another – Cooper, Heron & Heward, 2007), demonstrations (i.e., modelling), classes owners must attend, or a combination of these (i.e.,

package), lies mostly in the responsibility and skill set of the behaviorist and depends on the respective context in which the undesired behavior occurs.

All these approaches have in common the key assumption that *rule-following* will occur. The latter is defined as the effect of contingency-specifying discriminative stimuli (i.e., rules) on the listener's behavior. These stimuli could take the form of spoken, written and/or gestural instructions, rules, advice, maxims, and/or laws that signal reinforcement relations (Baum, 2017; Catania, Shimoff & Matthews, 1989; Skinner, 1984). For instance, an animal behaviorist provides following oral or written instruction (i.e., a rule) to the caregiver: "as soon as you enter the room and your dog has four paws on the floor you should deliver attention in form of praise and petting for about 20s." When these rule-type stimuli regulate operant behavior, the behavior is said to be rule governed, or that rule-following behavior has occurred (Baum, 2017; Pierce & Cheney, 2017). Occurrence and maintenance of rule-following behavior is explained functionally, i.e., that is, in terms of reinforcement relations (e.g., *tracking* - Hayes, Zettle & Rosenfarb, 1989). A rule describes that behaving in a specific way will produce reinforcement. If the actual occurrence of such prescribed behavior indeed produces the predicted reinforcement, the rule becomes an effective form of advice or instruction, and thus the related rule-following behavior increases the probability of reoccurring in the future (Skinner, 1984). In the previous example, if the dog owner behaves in the way the animal behaviorist's instruction stated and, as a result of that, the dog behaves more appropriately, the owner's rule-following behavior will be reinforced (i.e., the owner will keep doing what was instructed).

This example illustrates ultimate (i.e., long-term) relations of rule-following and respective reinforcement (i.e., the temporal gap between the moment in which the instruction is provided, the performance of the dog owner, and the occurrence of appropriate behavior of the dog that reinforces the rule following). However, it is well known that delay of reinforcement and ill-defined relations (e.g., imprecise or incomplete rules) are typically less

effective regulating behavior (Baum, 2017), which often leads to cessation of rule-following (i.e., "non-compliance"). Hence, more proximate reinforcement of rule-following is typically necessary, for that behavior to reoccur (Baum, 2017). Such proximate reinforcers are usually delivered by the behaviorist in the form of praise (e.g., "well done") in the context of the caregiver reproducing/simulating the instructed behavior. This in turn increases the probability of future occurrences of similar behavior in similar settings (e.g., when the dog owner attempts to train the dog on his own on a different scenario), and thus the natural reinforcement of rule following (i.e., producing the reinforcing consequence that the rule specifies; e.g., that the dog behaves in the desired manner).

This rule-following conceptual analysis, coupled with the fact that modelling and feedback involve immediate differential reinforcement of successive approximations to the target behavior of the caregiver during training (i.e., shaping – Cooper *et al.*, 2007), allowed us to predict that packages, modelling and feedback would have produced larger effects than solely oral or written instructions. This especially considering that the latter two interventions may produce only delayed reinforcement, if any at all. Although the fact that packages and oral instruction/advice both yielded similar moderate effects, which did not support our predictions, it should be noted that a detailed analysis of modelling, feedback, quality time and obedience instructions could not be conducted due to a very small number of studies, i.e., one or two for each intervention. Nevertheless, it seems plausible that the advantage of training packages may lie in the fact that they involve various approaches, some of them increasing aspects of caregiver performance, while others decrease different ones (e.g., constructive feedback). Though further research is clearly needed, it appears that effective and reliable interventions based on rule-following require that this behavior contacts reinforcement via the behaviorist and/or the natural setting. If this is not the case, effectiveness of individual components may decrease, and compliance of owners ultimately may break down.

After conducting the meta-regression, learner species was shown to have an influence on effectiveness of interventions with canine-related interventions being more effective than human-related ones (see Figure 5a). A possible reason for this finding may be that a small number of canine-related studies and the pre-test/post-test designs included in this subgroup artificially enlarged effect size estimates due to instrumental bias, maturation and/or order effects (Gravetter & Forzano, 2018). In general, learners seemed to be of younger age (i.e., puppies and adolescent dogs, adult dogs and children between one and eleven years), a finding that was also seen to influence effectiveness of interventions. These results are in line with existing literature which points to the notion that younger dogs may be more likely to engage in undesired behaviors, e.g., separation-related behaviors, and that among certain caregiver populations if dogs are acquired as puppies risks may be higher that the dogs are being relinquished at a later point (Blackwell *et al.*, 2008; Weng *et al.*, 2006). The fact that mostly younger learners were included in the studies may also hint to a "catch 'em early"-approach, i.e., that behavioral interventions are most effective when implemented at an early age (i.e., as soon as possible after diagnosis) and intensively (i.e., at least 20 h per week – Reichow, 2012; Rivard *et al*., 2017) in young human learners, for instance.

Meta-regression of year of publication (Figure 5c) shows that number of research output increased from the year 2005 onwards, and that overall effectiveness of studies decreased with progression of time. Simultaneously, CIs became notably narrower. The actual impact of the intervention likely falls somewhere in the range of the CI for any given effect size estimate (Borenstein *et al.*, 2009). These findings may hint to the notion that studies became more accurate over time, and that decreasing effectiveness may be a result of increased research output (Nelson, Wooditch & Dario, 2014). Another moderating variable was study duration. This analysis found that caregiver training and respective interventions were most effective when between three and six months long. This is in line with an earlier meta-analysis that also investigated the effectiveness of caregiver training (i.e., teachers).

Fukkink & Lont (2007) reported that the average duration of their investigated interventions was six months, potential moderating properties of study duration were not assessed, however.

Limitations

This meta-analytic review has several limitations. First, the applied search strategy led to high sensitivity (i.e., proportion of all studies retrieved by the search) but at the same time yielded low specificity (i.e., proportion of retrieved studies that were relevant) which resulted in relevant studies being hidden among many irrelevant sources (Petticrew & Roberts, 2006). Second, due to resource constrains, a quality assessment of eligible studies, such as the guidelines by the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group (Guyatt *et al.*, 2011) for group designs, What Works Clearinghouse Single-Case Design Technical Documentation (Kratochwill *et al.*, 2010) for SCDs, and Guidelines for Clinical Case Reports in Behavioral Clinical Psychology (Virues-Ortega & Moreno-Rodriguez, 2008) for case studies could not be conducted. Finally, a more detailed analysis of the training methods entailed in packages required that these components should have been extracted during the coding stage of the present study. Where possible, such approach would have permitted a comparison of treatment-package components with respective studies' effect size estimates.

Conclusions and future directions

This meta-analytic review found that (a) most canine-related papers were case studies, pointing to a lack of intervention research implementing other more robust methodologies (i.e., SCDs or group designs); (b) overall, interventions had a large effect on training outcomes across species; (c) intervention packages, as well as oral instruction/advice were moderately effective in behavior change outcomes for caregivers and learners; and (d)

interventions were most effective when between three and six months in duration irrespective of the learner species. Especially the latter two points are considered to have practical importance for a wide array of caregivers, such as dog owners, animal behaviorists and shelter staff.

Overall, more systematic and comparative research regarding the roles of caregivers in behavior change programs across species is needed. The field of human behavior change can inform canine-related research on how to more effectively teach owners how to train their dogs to help keeping them in their families and potentially reducing the number of dogs being relinquished to shelters due to behavior problems. Future primary research hopefully states in more detail which parts of the intervention were conducted by caregivers and report data on those procedures and respective integrity. Additionally, researchers should clearly state when they use a treatment package, describe its components and report results according to the components used. 8600 words

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Table 1. Characteristics of eligible studies.

Doc ID	Study (year)	Country	Species	Total Population	Learner Age	Learner Undesired Behaviour	Setting	Type of Study	Study Design	Intervention				Study Outcome Caregiver	Study Outcome Learner	Social Validity
										1	2	3	4			
1/1	Gazzano et al. (2008)	Italy	Canine	89	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Not clearly stated	Clinic-based	Group design	Nonequivalent control group (quasi-experimental)	Oral instruction/ advice	-	-	-	Positive	Mixed	Not clearly stated
2/1	Crockett et al. (2005)	USA	Human	2	Children (1 to 11 years)	Language/communication & motor skill deficits	Clinic-based	Single-case method	Multiple baseline across behaviours	Package	-	-	-	Positive	Mixed	Not clearly stated
3/1	Crone et al. (2016)	USA	Human	4	Children (1 to 11 years)	Undesired behaviour during meal times	Clinic or in-home	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Decrease undesired behaviour	Positive
4/1	Echterling-Savage et al. (2014)	USA	Canine	4	Mostly adult dogs (2 to 8 years)	Aggressive behaviour	In-home & dog training facility	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Decrease undesired behaviour	Positive
5/1	**Clark et al. (1993)**	USA	Canine	30	Mostly puppies & adolescent dogs (i.e. 2 months to 24 months)	Separation-related behaviours	Clinic or in-home	Group design	Nonequivalent control group (quasi-experimental)	Obedience training	Quality time	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
5/2	**Clark et al. (1993)**	USA	Canine	30	Mostly puppies & adolescent dogs (i.e. 2 months to 24 months)	Behaviour problems	Clinic or in-home	Group design	Nonequivalent control group (quasi-experimental)	Obedience training	Quality time	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
6/1	Ben et al. (2009)	USA	Human	2	Children (1 to 11 years)	Language/communication & motor skill deficits	In-home	Single-case method	Multiple baseline across behaviours	Package	-	-	-	Positive	Increase desired behaviour	Positive
7/1	Bennett et al. (2013)	USA	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Separation-related behaviours	Clinic or in-home	Case study	Case study	Oral instruction/ advice	-	-	-	Not clearly stated	Mixed	Not clearly stated
7/2	Bennett et al. (2013)	USA	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Fear & anxiety	Clinic or in-home	Case study	Case study	Oral instruction/ advice	-	-	-	Not clearly stated	Mixed	Not clearly stated
8/1	Berger et al. (2009)	USA	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Fear & anxiety	Clinic-based	Case study	Case study	Oral instruction/ advice	Written instruction/ advice	-	-	Not clearly stated	Increase desired behaviour	Positive
9/1	Berger et al. (1999)	Switzerland	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Fear & anxiety	Clinic or in-home	Case study	Case study	Oral instruction/ advice	Written instruction/ advice	-	-	Not clearly stated	Mixed	Mixed
10/1	**Blackwell et al. (2006)**	UK	Canine	55	Mostly adult dogs (2 to 8 years)	Separation-related behaviours	Clinic-based	Group design	Nonequivalent control group (quasi-experimental)	Package	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
10/2	**Blackwell et al. (2006)**	UK	Canine	30	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Separation-related behaviours	In-home	Case study	Case study	Package	-	-	-	Not clearly stated	Increase desired behaviour	Not clearly stated
11/1	**Blackwell et al. (2016)**	UK	Canine	306	Adult dogs (2 to 8 years)	Separation-related behaviours	In-home	Group design	Nonequivalent control group (quasi-experimental)	Written instruction/ advice	-	-	-	Mixed	Decrease undesired behaviour	Not clearly stated
12/1	**Brody et al. (2006)**	USA	Human	172	Children (1 to 11 years)	Not clearly stated	Community setting & in-home visits	Group design	Pre-test-post test (no control group)	Package	-	-	-	Positive	Not clearly stated	Not clearly stated
13/1	Butler et al. (2011)	New Zealand	Canine	8	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Separation-related behaviours	In-home	Single-case method	ABC design	Package	-	-	-	Not clearly stated	Decrease undesired behaviour	Positive
14/1	Buzhardt et al. (2016)	USA	Human	1	Children (1 to 11 years)	Not clearly stated	Community setting	Case study	Case study	Package	-	-	-	Positive	Not clearly stated	Not clearly stated
15/1	Camp et al. (2005)	USA	Human	600	Not clearly stated	Not clearly stated	Community setting	Group design	Pre-test-post test (no control group)	Package	-	-	-	Positive	Not clearly stated	Positive
16/1	**Crowell-Davis et al. (2003)**	USA	Canine	40	Adult dogs (2 to 8 years)	Fear & anxiety	Clinic or in-home	Group design	Pre-test-post test (no control group)	Package	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
17/1	Dodman et al. (2000)	USA	Canine	2	Adult dogs (2 to 8 years)	Aggressive behaviour	Clinic or in-home	Case study	Case study	Oral instruction/ advice	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated

Doc ID	Study (year)	Country	Species	Total Population	Learner Age	Learner Undesired Behaviour	Setting	Type of Study	Study Design	Intervention				Study Outcome Caregiver	Study Outcome Learner	Social Validity
										1	2	3	4			
18/1	Ducharme et al. (1996)	Canada	Human	5	Children (1 to 11 years)	Non-compliance & oppositional behaviour	In-home	Single-case method	Multiple baseline across groups	Package	-	-	-	Not clearly stated	Increase desired behaviour	Positive
19/1	Frank et al. (2005)	Canada	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Separation-related behaviours	Clinic or in-home	Case study	Case study	Oral instruction/ advice	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
20/1	**Haydicky et al. (2015)**	Canada	Human	44	Adolescents (12 to 18 years)	Inattantive & hyperactive symptoms	In-home	Group design	Pre-test-post test (no control group)	Package	-	-	-	Positive	Mixed	Not clearly stated
21/1	Hsieh et al. (1980)	USA	Human	3	Children (1 to 11 years)	Deficits in language, social interaction & academic skills	In-home & group home	Single-case method	Multiple baseline across participants	Package	Feedback	-	-	Positive	Mixed	Not clearly stated
22/1	**Ilg et al. (2016)**	France	Human	15	Children (1 to 11 years)	Autism Spectrum Disorder & language delays	Clinic or in-home	Group design	Pre-test-post test (no control group)	Package	-	-	-	Mixed	Mixed	Mixed
23/1	**Jang et al. (2012)**	USA	Human	28	Children (1 to 11 years)	Not clearly stated	In-home	Group design	Randomised controlled trial	Package	-	-	-	Positive	Not clearly stated	Positive
24/1	Giebenhain et al. (1984)	USA	Human	11	Children (1 to 11 years)	Fear & anxiety	In-home	Single-case method	Multiple baseline across participants	Written instruction/ advice	-	-	-	Not clearly stated	Decrease undesired behaviour	Positive
25/1	Joyce et al. (1976)	USA	Human	5	Children (1 to 11 years)	Language delays	In-home & school	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Mixed	Not clearly stated
26/1	Laski et al. (1988)	USA	Human	8	Children (1 to 11 years)	Autism Spectrum Disorder & language delays	Clinic or in-home	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Increase desired behaviour	Not clearly stated
27/1	Kirkpatrick et al. (1972)	USA	Canine	1	Mostly senior dogs (> 8 years)	Behaviour problems	In-home	Case study	Case study	Oral instruction/ advice	-	-	-	Not clearly stated	Increase desired behaviour	Not clearly stated
28/1	Lafasakis et al. (2007)	USA	Human	3	Children (1 to 11 years)	Language delays	Special education school	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Increase desired behaviour	Not clearly stated
29/1	Delgado et al. (1988)	USA	Human	6	Infants (0 to 1 year)	Not clearly stated	In-home	Single-case method	Multiple probe	Written instruction/ advice	Modelling & role play	-	-	Positive	Not clearly stated	Positive
30/1	Lem et al. (2002)	Canada	Canine	1	Adult dogs (2 to 8 years)	Separation-related behaviours	In-home	Case study	Case study	Oral instruction/ advice	Written instruction/ advice	-	-	Not clearly stated	Mixed	Not clearly stated
31/1	Heitzman-Powell et al. (2009)	USA	Human	10	Not clearly stated	Not clearly stated	Clinic or in-home	Group design	Pre-test-post test (no control group)	Package	Written instruction/ advice	Oral instruction/ advice	-	Positive	Not clearly stated	Positive
32/1	**Lindgren et al. (2016)**	USA	Human	107	Children (1 to 11 years)	Behaviour problems	Clinic or in-home	Group design	Nonequivalent control group (quasi-experimental)	Package	-	-	-	Not clearly stated	Decrease undesired behaviour	Positive
33/1	Lucyshyn et al. (2015)	Canada	Human	12	Children (1 to 11 years)	Behaviour problems	In-home	Single-case method	Multiple baseline across settings	Package	-	-	-	Positive	Decrease undesired behaviour	Positive
33/2	**Lucyshyn et al. (2015)**	Canada	Human	12	Children (1 to 11 years)	Behaviour problems	In-home	Group design	Pre-test-post test (no control group)	Package	-	-	-	Positive	Decrease undesired behaviour	Positive
34/1	Feldman et al. (1989)	Canada	Human	3	Children (1 to 11 years)	Language delays	In-home	Single-case method	Multiple baseline across participants	Oral instruction/ advice	Package	-	-	Positive	Increase desired behaviour	Not clearly stated
35/1	Feldman et al. (1992)	Canada	Human	11	Infants (0 to 1 year)	Not clearly stated	In-home	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Not clearly stated	Positive
36/1	Feldman et al. (1986)	Canada	Human	6	Infants (0 to 1 year)	Not clearly stated	In-home & group home	Single-case method	Multiple baseline across behaviours	Package	-	-	-	Positive	Increase desired behaviour	Not clearly stated
37/1	**Minjarez Boettcher et al. (2011)**	USA	Human	26	Children (1 to 11 years)	Autism Spectrum Disorder & language delays	Clinic-based	Group design	Pre-test-post test (no control group)	Package	-	-	-	Positive	Increase desired behaviour	Not clearly stated
38/1	Najdowski et al. (2010)	USA	Human	3	Children (1 to 11 years)	Undesired behaviour during meal times	In-home	Single-case method	Multiple baseline across participants	Package	-	-	-	Mixed	Decrease undesired behaviour	Positive

Doc ID	Study (year)	Country	Species	Total Population	Learner Age	Learner Undesired Behaviour	Setting	Type of Study	Study Design	Intervention				Study Outcome Caregiver	Study Outcome Learner	Social Validity
										1	2	3	4			
39/1	Neef et al. (1995)	USA	Human	26	Children (1 to 11 years)	Behavioural deficits	In-home & school	Single-case method	Multiple probe	Package	-	-	-	Positive	Increase desired behaviour	Not clearly stated
40/1	Miles et al. (2009)	USA	Human	3	Children (1 to 11 years)	Non-compliance & oppositional behaviour	In-home & school	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Increase desired behaviour	Not clearly stated
41/1	Pangborn et al. (2013)	USA	Human	4	Children (1 to 11 years)	Undesired behaviour during meal times	Clinic-based	Single-case method	Multiple baseline across participants	Written instruction/ advice	Video modelling	Feedback	Modelling	Mixed	Decrease undesired behaviour	Positive
42/1	Podberscek et al. (1999)	UK	Canine	49	Mostly adult dogs (2 to 8 years)	Separation-related behaviours	In-home	Group design	Randomised controlled trial	Oral instruction/ advice	Written instruction/ advice	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
43/1	Pryor et al. (2003)	USA	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Fear & anxiety	Clinic or in-home	Case study	Case study	Oral instruction/ advice	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
44/1	Miltenberger et al. (2013)	USA	Human	27	Children (1 to 11 years)	Not clearly stated	In-home, clinic & community	Group design	Nonequivalent control group (quasi-experimental)	Package	-	-	-	Positive	Increase desired behaviour	Positive
45/1	**Reitzel et al. (2013)**	Canada	Human	26	Children (1 to 11 years)	Deficits in language, social interaction & academic skills	Clinic-based	Group design	Randomised controlled trial	Package	-	-	-	Positive	Decrease undesired behaviour	Not clearly stated
46/1	Reich et al. (1999)	USA	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Aggressive behaviour	Clinic-based	Case study	Case study	Oral instruction/ advice	-	-	-	Positive	Decrease undesired behaviour	Not clearly stated
47/1	Rivard et al. (2017)	Canada	Human	94	Children (1 to 11 years)	Behaviour problems	In-home, clinic & community	Group design	Pre-test-post test (no control group)	Package	-	-	-	Positive	Increase desired behaviour	Positive
48/1	Koegel et al. (1978)	USA	Human	4	Children (1 to 11 years)	Behaviour problems	Child development center	Single-case method	Multiple baseline across participants	Modelling	Package	-	-	Positive	Increase desired behaviour	Not clearly stated
49/1	Wahler et al. (2004)	USA	Human	3	Children (1 to 11 years)	Oppositional behaviour	In-home & school	Single-case method	Reversal/withdrawal	Package	-	-	-	Positive	Decrease undesired behaviour	Not clearly stated
50/1	**Rostad et al. (2017)**	USA	Human	312	Mostly children (1 to 11 years)	Not clearly stated	In-home	Group design	Pre-test-post test (no control group)	Package	-	-	-	Positive	Not clearly stated	Not clearly stated
51/1	**Rudy et al. (2017)**	USA	Human	22	Children (1 to 11 years)	Fear & anxiety	Clinic-based	Group design	Randomised controlled trial	Package	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
52/1	Herbert et al. (1973)	USA	Human	6	Children (1 to 11 years)	Behaviour problems	School & clinic	Single-case method	Reversal/withdrawal	Package	-	-	-	Mixed	Increase undesired behaviour	Not clearly stated
53/1	**Saunders et al. (2013)**	USA	Human	52	Children (1 to 11 years)	Not clearly stated	Child development center	Group design	Nonequivalent control group (quasi-experimental)	Oral instruction/ advice	Modelling	-	-	Positive	Not clearly stated	Not clearly stated
54/1	**Schoenfelder et al. (2013)**	USA	Human	90	Children (1 to 11 years)	Not clearly stated	In-home & school	Group design	Randomised controlled trial	Package	-	-	-	Positive	Not clearly stated	Positive
55/1	Seiverling et al. (2012)	USA	Human	3	Children (1 to 11 years)	Undesired behaviour during meal times	In-home	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Increase desired behaviour	Positive
56/1	Seksel et al. (2001)	Australia	Canine	24	Mostly puppies & adolescent dogs (i.e. 2 months to 24 months)	Stereotypic behaviour	Clinic or in-home	Case study	Case study	Oral instruction/ advice	Written instruction/ advice	-	-	Mixed	Mixed	Not clearly stated
56/2	Seksel et al. (2001)	Australia	Canine	24	Mostly puppies & adolescent dogs (i.e. 2 months to 24 months)	Separation-related behaviours	Clinic or in-home	Case study	Case study	Oral instruction/ advice	Written instruction/ advice	-	-	Positive	Mixed	Not clearly stated
56/3	Seksel et al. (2001)	Australia	Canine	24	Mostly puppies & adolescent dogs (i.e. 2 months to 24 months)	Fear & anxiety	Clinic or in-home	Case study	Case study	Oral instruction/ advice	Written instruction/ advice	-	-	Mixed	Mixed	Not clearly stated
57/1	Stelow et al. (2016)	USA	Canine	1	Senior dogs (> 8 years)	Fear & anxiety	Clinic or in-home	Case study	Case study	Oral instruction/ advice	Written instruction/ advice	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
57/2	Stelow et al. (2016)	USA	Canine	1	Senior dogs (> 8 years)	Aggressive behaviour	Clinic or in-home	Case study	Case study	Oral instruction/ advice	Written instruction/ advice	-	-	Not clearly stated	Decrease undesired behaviour	Positive

Doc ID	Study (year)	Country	Species	Total Population	Learner Age	Learner Undesired Behaviour	Setting	Type of Study	Study Design	Intervention				Study Outcome Caregiver	Study Outcome Learner	Social Validity
										1	2	3	4			
58/1	**Pelham et al. (1980)**	USA	Human	9	Children (1 to 11 years)	Oppositional behaviour	School & clinic	Group design	Pre-test-post test (no control group)	Package	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
58/2	**Pelham et al. (1980)**	USA	Human	9	Children (1 to 11 years)	Oppositional behaviour	School & clinic	Group design	Randomised controlled trial	Package	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
59/1	Young et al. (2012)	Canada	Human	5	Children (1 to 11 years)	Not clearly stated	In-home	Single-case method	Multiple baseline across participants	Written instruction/ advice	Video modelling	-	-	Positive	Not clearly stated	Positive
59/2	Young et al. (2012)	Canada	Human	5	Children (1 to 11 years)	Not clearly stated	Clinic or in-home	Single-case method	ABC design	Package	Video modelling	-	-	Positive	Not clearly stated	Positive
60/1	Voith et al. (1980)	USA	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Hyperactivity	In-home	Case study	Case study	Oral instruction/ advice	Modelling	-	-	Positive	Decrease undesired behaviour	Not clearly stated
61/1	Suess et al. (2016)	USA	Human	5	Children (1 to 11 years)	Autism Spectrum Disorder & language delays	Clinic-based	Single-case method	Multiple baseline across participants	Feedback	-	-	-	Positive	Decrease undesired behaviour	Not clearly stated
62/1	**Cottam et al. (2008)**	USA	Canine	201	Not clearly stated	Separation-related behaviours	Clinic or in-home	Group design	Nonequivalent control group (quasi-experimental)	Oral instruction/ advice	Written instruction/ advice	-	-	Not clearly stated	Mixed	Mixed
63/1	Mulford et al. (2011)	USA	Human	2	Children (1 to 11 years)	Language delays	In-home	Single-case method	Multiple baseline across participants	Package	-	-	-	Positive	Not clearly stated	Positive
64/1	Overall et al. (1998)	USA	Canine	1	Senior dogs (> 8 years)	Stereotypic behaviour	Clinic or in-home	Case study	Case study	Oral instruction/ advice	-	-	-	Positive	Decrease undesired behaviour	Not clearly stated
65/1	Pike et al. (2016)	USA	Canine	1	Puppies & adolescent dogs (i.e. 2 months to 24 months)	Stereotypic behaviour	Clinic or in-home	Case study	Case study	Oral instruction/ advice	-	-	-	Not clearly stated	Decrease undesired behaviour	Not clearly stated
66/1	Stewart et al. (2007)	USA	Human	1	Children (1 to 11 years)	Behavioural deficits	Clinic-based	Case study	AB design	Oral instruction/ advice	Modelling	Feedback	-	Positive	Increase desired behaviour	Positive

Note. Studies highlighted in bold font were included in the meta-analytic comparison.
Doc ID = Document identification number. The numbers after the slash indicate the number of arms per respective study. An additional arm was introduced when the study either used a second study design or investigated other undesired behaviors (i.e. separation anxiety and other behavior problems).

Table 2. Participant characteristics of included studies displayed by canine- and human-related studies across all designs.

Participant characteristic of included studies		COUNT		PERCENT		TOTAL	
Characteristic	**Type**	**Human**	**Canine**	**Human**	**Canine**	**Count**	**Percent**
Single-case designs							
Caregiver Population	Mothers	16	0	57%	0%	16	57%
	Universal (both female and male participants)	7	0	25%	0%	7	25%
	Not clearly stated	0	2	0%	7%	2	7%
	Parents & other caregivers	2	0	7%	0%	2	7%
	Both parents	1	0	4%	0%	1	4%
	TOTAL	**26**	**2**	**93%**	**7%**	**28**	**100%**
Caregiver Education	Not clearly stated	15	2	54%	7%	17	61%
	Low (secondary school)	6	0	21%	0%	6	21%
	Medium (under graduate)	5	0	18%	0%	5	18%
	TOTAL	**26**	**2**	**93%**	**7%**	**28**	**100%**
Caregiver Gender	All female	17	0	61%	0%	17	61%
	Mostly female	5	0	18%	0%	5	18%
	Not clearly stated	1	2	4%	7%	3	11%
	Both	3	0	11%	0%	3	11%
	TOTAL	**26**	**2**	**93%**	**7%**	**28**	**100%**
Learner Gender/Sex	All male	9	0	32%	0%	9	32%
	Mostly male	8	0	29%	0%	8	29%
	Mostly female	5	1	18%	4%	6	21%
	Both	2	1	7%	4%	3	11%
	Not clearly stated	2	0	7%	0%	2	7%
	TOTAL	**26**	**2**	**93%**	**7%**	**28**	**100%**
Learner Age	Children (1 to 11 years)	23	0	82%	0%	23	82%
	Infants (0 to 1 year)	3	0	11%	0%	3	11%
	Mostly adult dogs (2 to 8 years)	0	1	0%	4%	1	4%
	Puppies & adolescent dogs (i.e. 2 months to 24 months)	0	1	0%	4%	1	4%
	TOTAL	**26**	**2**	**93%**	**7%**	**28**	**100%**
Group designs							
Caregiver Population	Universal (both female and male participants)	12	3	48%	12%	15	60%
	Not clearly stated	0	4	0%	16%	4	16%
	Mothers	4	0	16%	0%	4	16%
	Both parents	1	0	4%	0%	1	4%
	Parents & other caregivers	1	0	4%	0%	1	4%
	TOTAL	**18**	**7**	**72%**	**28%**	**25**	**100%**
Caregiver Education	Not clearly stated	10	6	40%	24%	16	64%
	Medium (under graduate)	6	0	24%	0%	6	24%
	Low (secondary school)	2	1	8%	4%	3	12%
	TOTAL	**18**	**7**	**72%**	**28%**	**25**	**100%**
Caregiver Gender	Not clearly stated	6	5	24%	20%	11	44%
	Mostly female	4	2	16%	8%	6	24%
	All female	4	0	16%	0%	4	16%
	Both	4	0	16%	0%	4	16%
	TOTAL	**18**	**7**	**72%**	**28%**	**25**	**100%**
Learner Gender/Sex	Mostly male	8	3	32%	12%	11	44%
	Not clearly stated	3	2	12%	8%	5	20%
	Both	5	0	20%	0%	5	20%
	Mostly female	1	2	4%	8%	3	12%
	All male	1	0	4%	0%	1	4%
	TOTAL	**18**	**7**	**72%**	**28%**	**25**	**100%**
Learner Age	Children (1 to 11 years)	14	0	56%	0%	14	56%
	Not clearly stated	2	1	8%	4%	3	12%
	Adult dogs (2 to 8 years)	0	2	0%	8%	2	8%
	Mostly adult dogs (2 to 8 years)	0	2	0%	8%	2	8%
	Adolescents (12 to 18 years)	1	0	4%	0%	1	4%
	Puppies & adolescent dogs (i.e. 2 months to 24 months)	0	1	0%	4%	1	4%
	Mostly children (1 to 11 years)	1	0	4%	0%	1	4%
	Mostly puppies & adolescent dogs (i.e. 2 months to 24 months)	0	1	0%	4%	1	4%
	TOTAL	**18**	**7**	**72%**	**28%**	**25**	**100%**
Case studies							
Caregiver Population	Universal (both female and male participants)	0	7	0%	41%	7	41%
	Not clearly stated	0	6	0%	35%	6	35%
	Female dog owners	0	2	0%	12%	2	12%
	Mothers	1	0	6%	0%	1	6%
	Parents & other caregivers	1	0	6%	0%	1	6%
	TOTAL	**2**	**15**	**12%**	**88%**	**17**	**100%**
Caregiver Education	Not clearly stated	1	14	6%	82%	15	88%
	Low (secondary school)	1	0	6%	0%	1	6%
	Medium (under graduate)	0	1	0%	6%	1	6%
	TOTAL	**2**	**15**	**12%**	**88%**	**17**	**100%**
Caregiver Gender	Both	0	7	0%	41%	7	41%
	Not clearly stated	0	6	0%	35%	6	35%
	All female	2	2	12%	12%	4	24%
	TOTAL	**2**	**15**	**12%**	**88%**	**17**	**100%**
Learner Gender/Sex	Male/neutered	0	6	0%	35%	6	35%
	Female/neutered	0	3	0%	18%	3	18%
	Female/intact	0	3	0%	18%	3	18%
	Not clearly stated	0	2	0%	12%	2	12%
	All male	2	0	12%	0%	2	12%
	Both	0	1	0%	6%	1	6%
	TOTAL	**2**	**15**	**12%**	**88%**	**17**	**100%**
Learner Age	Puppies & adolescent dogs (i.e. 2 months to 24 months)	0	9	0%	53%	9	53%
	Senior dogs (> 8 years)	0	2	0%	12%	2	12%
	Children (1 to 11 years)	2	0	12%	0%	2	12%
	Adult dogs (2 to 8 years)	0	2	0%	12%	2	12%
	Mostly senior dogs (> 8 years)	0	1	0%	6%	1	6%
	Mostly puppies & adolescent dogs (i.e. 2 months to 24 months)	0	1	0%	6%	1	6%
	TOTAL	**2**	**15**	**12%**	**88%**	**17**	**100%**

Note. Percentages have been rounded and may not total 100%. A total of 70 study designs were coded within all studies, yielding 75 undesired learner behaviours

Table 3. Overview of types of research designs, intervention types and learner undesired behaviors distributed across canine-related papers.

Types of research designs	Intervention type	Count	Percent
	Learner undesired behaviours		
Case studies		**19**	**66%**
	Oral instruction/advice	**9**	**31%**
	Stereotypic behaviour	2	7%
	Separation-related behaviours	2	7%
	Aggressive behaviour	2	7%
	Fear & anxiety	2	7%
	Behaviour problems	1	3%
	Oral instruction/advice + Written instruction/advice	**8**	**28%**
	Fear & anxiety	4	14%
	Separation-related behaviours	2	7%
	Stereotypic behaviour	1	3%
	Aggressive behaviour	1	3%
	Oral instruction/advice + Modelling	**1**	**3%**
	Hyperactivity	1	3%
	Package	**1**	**3%**
	Separation-related behaviours	1	3%
Group designs		**8**	**28%**
	Package	**2**	**7%**
	Separation-related behaviours	1	3%
	Fear & anxiety	1	3%
	Oral instruction/advice + Written instruction/advice	**2**	**7%**
	Separation-related behaviours	2	7%
	Obedience training + Quality time	**1**	**3%**
	Separation-related behaviours	1	3%
	Behaviour problems	1	3%
	Written instruction/advice	**1**	**3%**
	Separation-related behaviours	1	3%
	Oral instruction/advice	**1**	**3%**
	Not clearly stated	1	3%
Single-case designs		**2**	**7%**
	Package	**2**	**7%**
	Separation-related behaviours	1	3%
	Aggressive behaviour	1	3%
	TOTAL	**29**	**100%**

Note. Percentages have been rounded and may not total 100%.

Table 4. Overview of types of research designs, intervention types and learner undesired behaviors distributed across human-related papers.

Types of research designs	Intervention type	Count	Percentage
	Learner undesired behaviours		
Single-case designs		**26**	**57%**
	Package	**17**	**37%**
	Undesired behaviour during meal times	3	7%
	Language delays	3	7%
	Not clearly stated	2	4%
	Behaviour problems	2	4%
	Non-compliance & oppositional behaviour	2	4%
	Language/communication & motor skill deficits	2	4%
	Oppositional behaviour	1	2%
	Behavioural deficits	1	2%
	Autism Spectrum Disorder & language delays	1	2%
	Package + Video modelling	**1**	**2%**
	Not clearly stated	1	2%
	Modelling + Package	**1**	**2%**
	Behaviour problems	1	2%
	Written instruction/advice + Video modelling + Feedback + Modelling	**1**	**2%**
	Undesired behaviour during meal times	1	2%
	Package + Feedback	**1**	**2%**
	Deficits in language, social interaction & academic skills	1	2%
	Written instruction/advice + Video modelling	**1**	**2%**
	Not clearly stated	1	2%
	Written instruction/advice + Modelling & role play	**1**	**2%**
	Not clearly stated	1	2%
	Written instruction/advice	**1**	**2%**
	Fear & anxiety	1	2%
	Feedback	**1**	**2%**
	Autism Spectrum Disorder & language delays	1	2%
	Oral instruction/advice + Package	**1**	**2%**
	Language delays	1	2%
Group designs		**18**	**39%**
	Package	**16**	**35%**
	Not clearly stated	6	13%
	Behaviour problems	3	7%
	Autism Spectrum Disorder & language delays	2	4%
	Oppositional behaviour	2	4%
	Inattantive & hyperactive symptoms	1	2%
	Deficits in language, social interaction & academic skills	1	2%
	Fear & anxiety	1	2%
	Oral instruction/advice + Modelling	**1**	**2%**
	Not clearly stated	1	2%
	Package + Written instruction/advice + Oral instruction/advice	**1**	**2%**
	Not clearly stated	1	2%
Case studies		**2**	**4%**
	Oral instruction/advice + Modelling + Feedback	**1**	**2%**
	Behavioural deficits	1	2%
	Package	**1**	**2%**
	Not clearly stated	1	2%
	TOTAL	**46**	**100%**
Note. Percentages have been rounded and may not total 100%.			

Table 5. Overview of distribution of caregiver training outcomes displayed by type of research designs and intervention types for canine-related studies.

Types of research designs	Outcome	Total	Percentage
	Intervention type		
Case studies		**19**	**66%**
	Not clearly stated	**13**	**45%**
	Oral instruction/advice	7	24%
	Oral instruction/advice + Written instruction/advice	5	17%
	Package	1	3%
	Positive	**4**	**14%**
	Oral instruction/advice	2	7%
	Oral instruction/advice + Modelling	1	3%
	Oral instruction/advice + Written instruction/advice	1	3%
	Mixed	**2**	**7%**
	Oral instruction/advice + Written instruction/advice	2	7%
Group designs		**8**	**28%**
	Not clearly stated	**6**	**21%**
	Package	2	7%
	Oral instruction/advice + Written instruction/advice	2	7%
	Obedience training + Quality time	1	3%
	Mixed	**1**	**3%**
	Written instruction/advice	1	3%
	Positive	**1**	**3%**
	Oral instruction/advice	1	3%
Single-case designs		**2**	**7%**
	Not clearly stated	**1**	**3%**
	Package	1	3%
	Positive	**1**	**3%**
	Package	1	3%
	TOTAL	**29**	**100%**
Note. Percentages have been rounded and may not total 100%.			

Table 6. Overview of distribution of caregiver training outcomes displayed by type of research designs and intervention types for human-related studies.

Types of research designs	Outcome	Total	Percentage
	Intervention type		
Single-case designs		**26**	**57%**
	Positive	**21**	**46%**
	Package	14	30%
	Modelling + Package	1	2%
	Package + Video modelling	1	2%
	Written instruction/advice + Video modelling	1	2%
	Written instruction/advice + Modelling & role play	1	2%
	Package + Feedback	1	2%
	Feedback	1	2%
	Oral instruction/advice + Package	1	2%
	Mixed	**3**	**7%**
	Package	2	4%
	Written instruction/advice + Video modelling + Feedback + Modelling	1	2%
	Not clearly stated	**2**	**4%**
	Written instruction/advice	1	2%
	Package	1	2%
Group designs		**18**	**39%**
	Positive	**13**	**28%**
	Package	11	24%
	Oral instruction/advice + Modelling	1	2%
	Package + Written instruction/advice + Oral instruction/advice	1	2%
	Not clearly stated	**4**	**9%**
	Package	4	9%
	Mixed	**1**	**2%**
	Package	1	2%
Case studies		**2**	**4%**
	Positive	**2**	**4%**
	Oral instruction/advice + Modelling + Feedback	1	2%
	Package	1	2%
	TOTAL	**46**	**100%**
Note. Percentages have been rounded and may not total 100%.			

Table 7. Learner outcomes across research designs and caregiver training for canine-related studies.

Types of research designs	Learner outcome	Total	Percentage
	Caregiver training approach		
Case studies		**19**	**66%**
	Decrease undesired behaviour	**9**	**31%**
	Oral instruction/advice	6	21%
	Oral instruction/advice + Written instruction/advice	2	7%
	Oral instruction/advice + Modelling	1	3%
	Mixed	**7**	**24%**
	Oral instruction/advice + Written instruction/advice	5	17%
	Oral instruction/advice	2	7%
	Increase desired behaviour	**3**	**10%**
	Oral instruction/advice	1	3%
	Oral instruction/advice + Written instruction/advice	1	3%
	Package	1	3%
Group designs		**8**	**28%**
	Decrease undesired behaviour	**6**	**21%**
	Package	2	7%
	Obedience training + Quality time	2	7%
	Written instruction/advice	1	3%
	Oral instruction/advice + Written instruction/advice	1	3%
	Mixed	**2**	**7%**
	Oral instruction/advice + Written instruction/advice	1	3%
	Oral instruction/advice	1	3%
Single-case designs		**2**	**7%**
	Decrease undesired behaviour	**2**	**7%**
	Package	2	7%
	TOTAL	**29**	**100%**
Note. Percentages have been rounded and may not total 100%.			

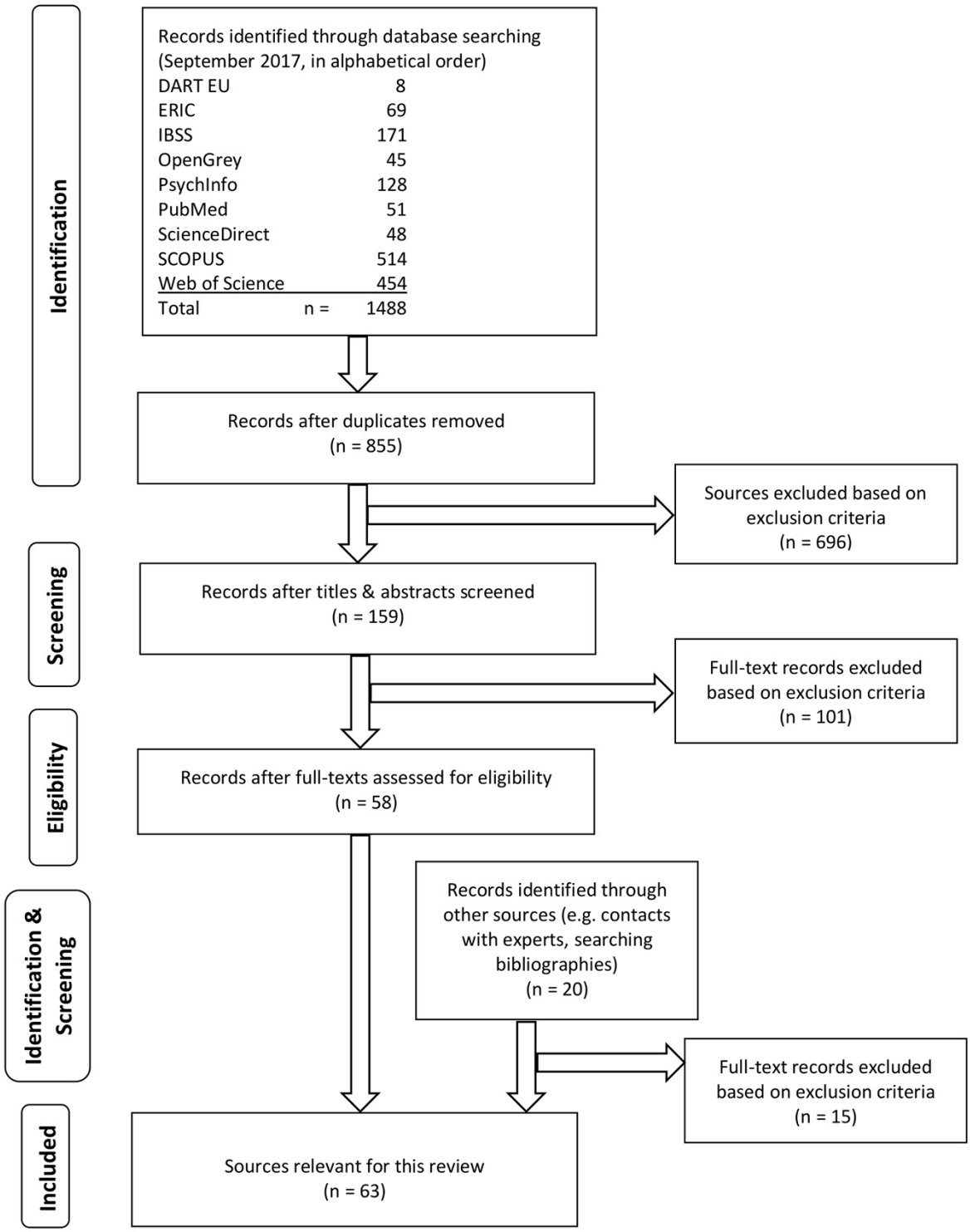
Table 8. Learner outcomes across research designs and caregiver training for human-related studies.

Types of research designs	Learner outcome	Total	Percentage
	Caregiver training approach		
Single-case designs		**26**	**57%**
	Increase desired behaviour	**10**	**22%**
	Package	8	17%
	Modelling + Package	1	2%
	Oral instruction/advice + Package	1	2%
	Decrease undesired behaviour	**7**	**15%**
	Package	4	9%
	Written instruction/advice + Video modelling + Feedback + Modelling	1	2%
	Feedback	1	2%
	Written instruction/advice	1	2%
	Not clearly stated	**5**	**11%**
	Package	2	4%
	Written instruction/advice + Video modelling	1	2%
	Package + Video modelling	1	2%
	Written instruction/advice + Modelling & role play	1	2%
	Mixed	**3**	**7%**
	Package	2	4%
	Package + Feedback	1	2%
	Increase undesired behaviour	**1**	**2%**
	Package	1	2%
Group designs		**18**	**39%**
	Not clearly stated	**7**	**15%**
	Package	5	11%
	Oral instruction/advice + Modelling	1	2%
	Package + Written instruction/advice + Oral instruction/advice	1	2%
	Decrease undesired behaviour	**6**	**13%**
	Package	6	13%
	Increase desired behaviour	**3**	**7%**
	Package	3	7%
	Mixed	**2**	**4%**
	Package	2	4%
Case studies		**2**	**4%**
	Not clearly stated	**1**	**2%**
	Package	1	2%
	Increase desired behaviour	**1**	**2%**
	Oral instruction/advice + Modelling + Feedback	1	2%
	TOTAL	**46**	**100%**
Note. Percentages have been rounded and may not total 100%.			

Table 9. Meta-regression results across all six variables.

Moderator variables	Number of covariates	*Q*	*p*-value	R^2 (%)
Intervention type	6	4.43	0.48	1
Study design	3	1.4	0.49	0
Learner species	2	10.98	0.0009*	25
Learner age	5	15.39	0.004*	29
Publication year	2	9.25	0.0024*	4
Study duration	5	11.67	0.02*	8

Note. *Q* is a statistic used to test the significance of the meta-regression. Statistically significant *p*-values (i.e., $p<0.05$) are indicated by an asterisk. R^2 is the proportion of variance explained by the moderator.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(September 2017, in alphabetical order)
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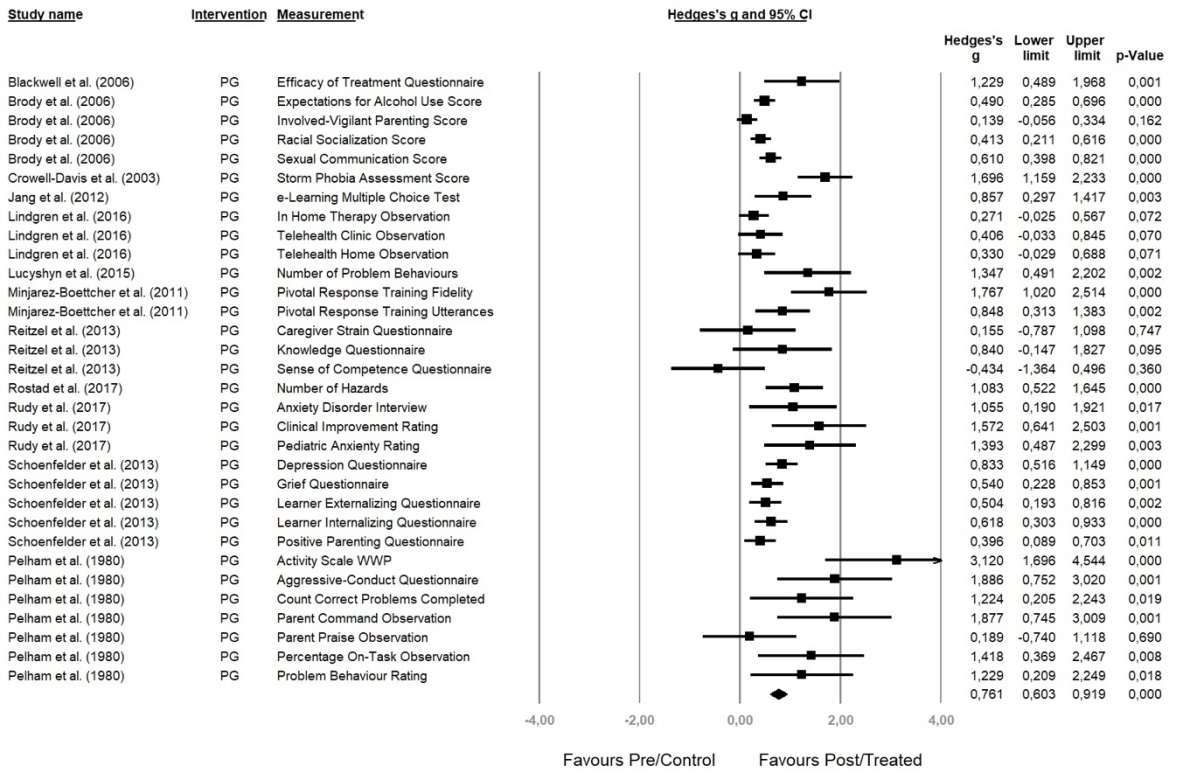
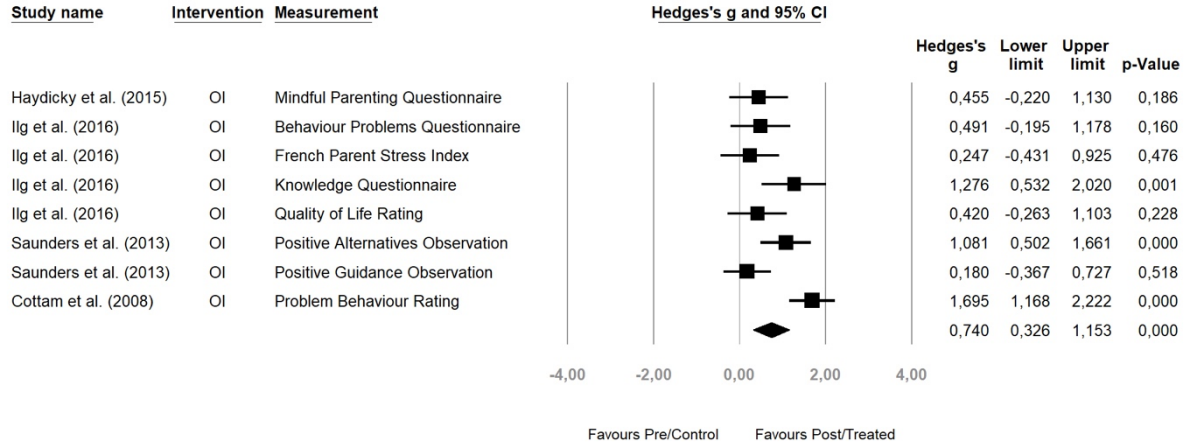
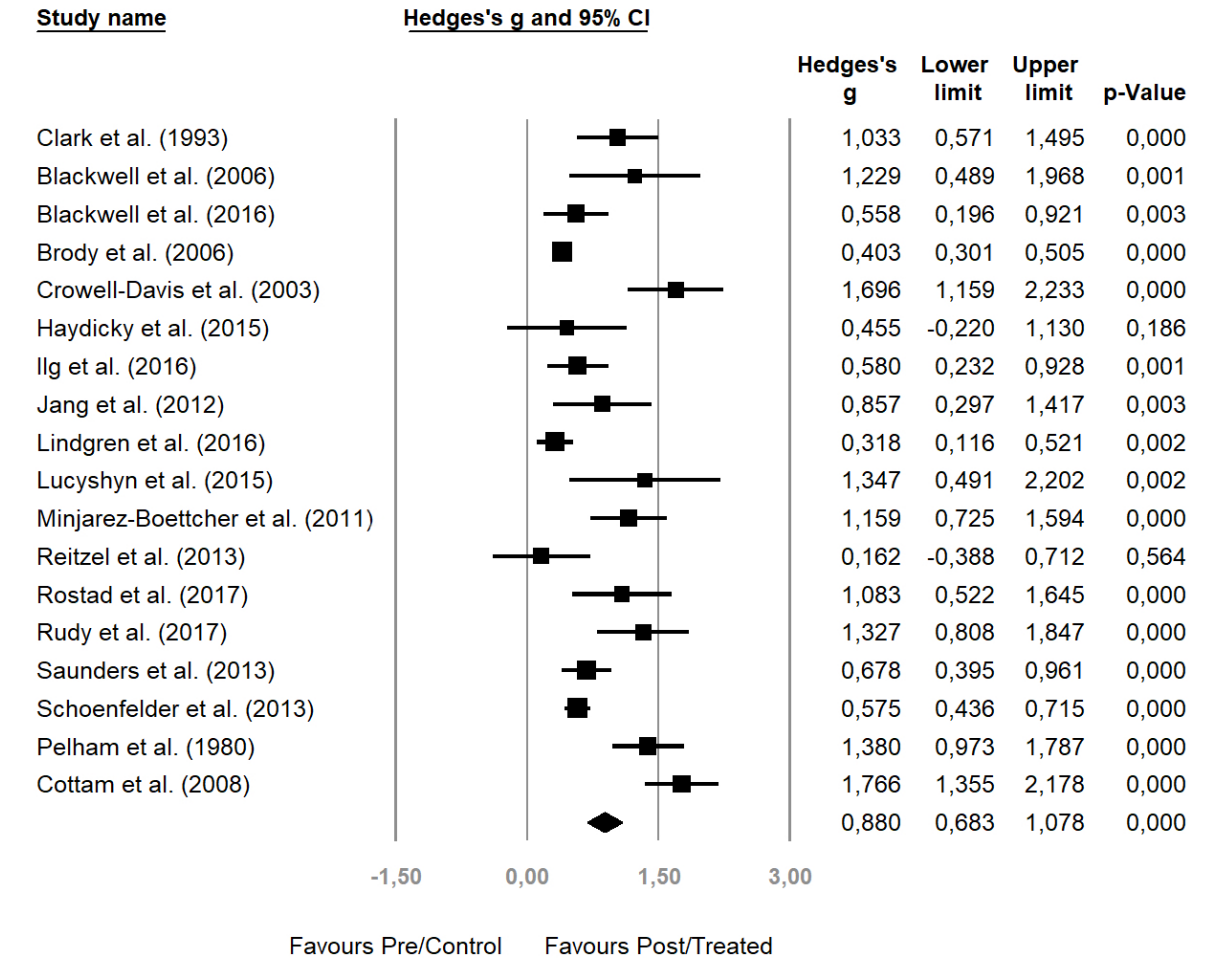
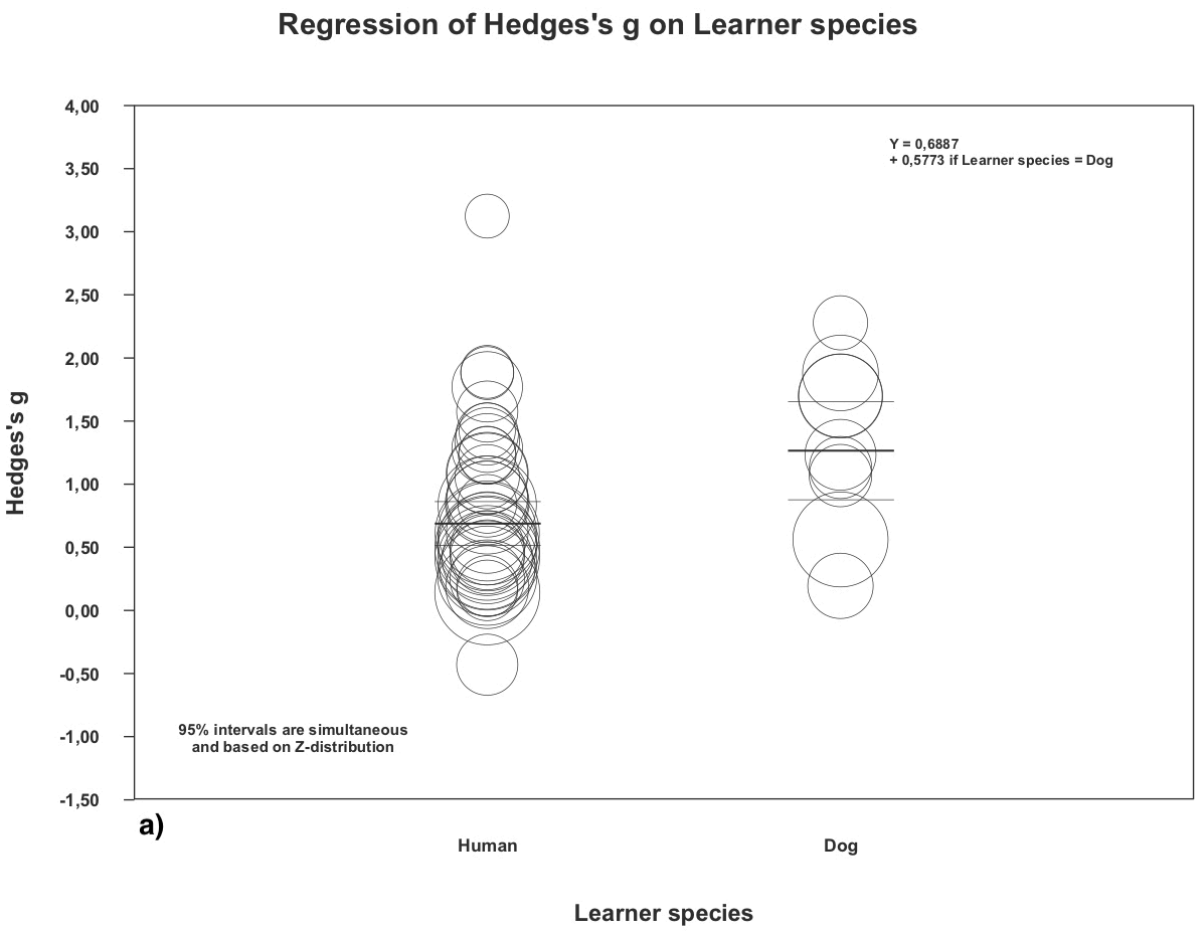
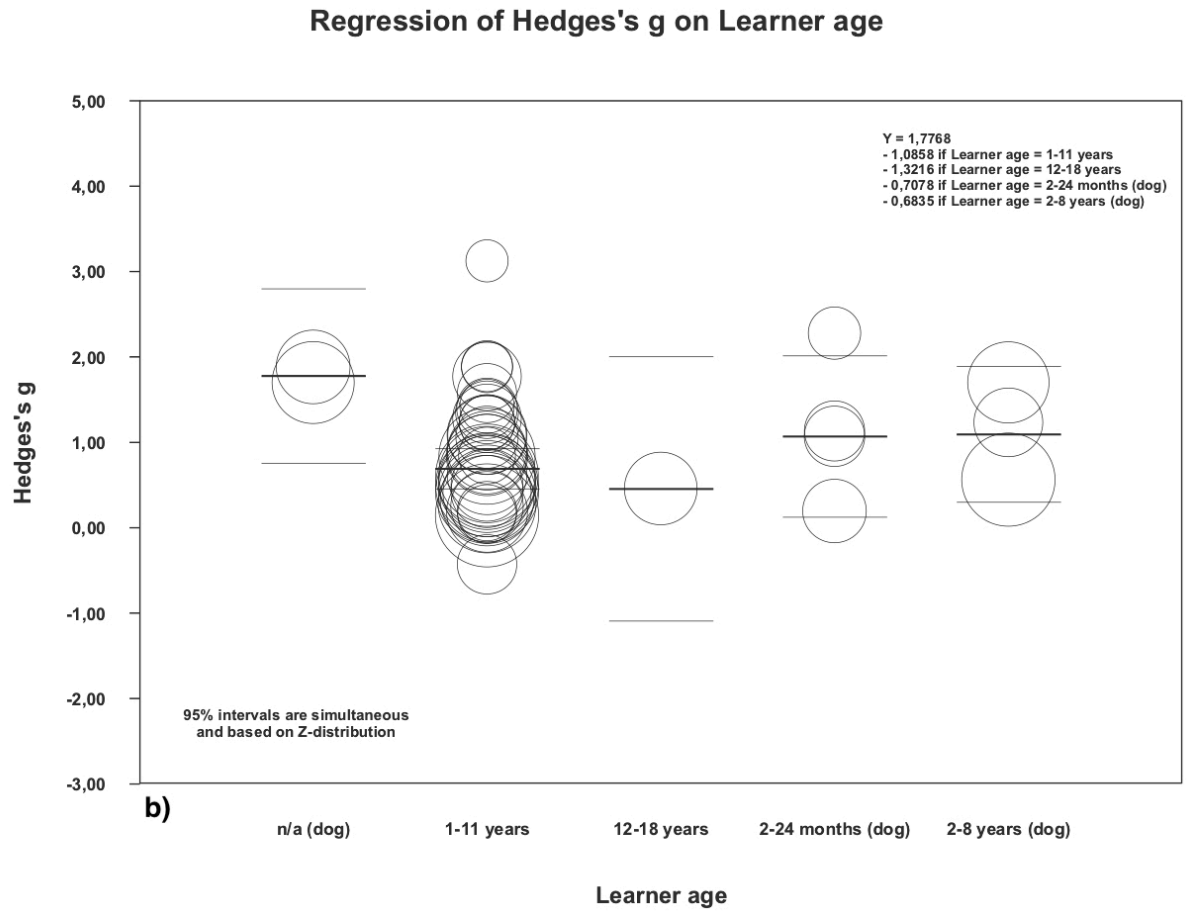
IBSS 171
OpenGrey 45
PsychInfo 128
PubMed 51
ScienceDirect 48
SCOPUS 514
Web of Science 454
Total n = 1488
Records after duplicates removed
(n = 855)
Sources excluded based on exclusion criteria
(n = 696)
Screening
Records after titles & abstracts screened
(n = 159)
Full-text records excluded based on exclusion criteria
(n = 101)
Eligibility
Records after full-texts assessed for eligibility
(n = 58)
Identification & Screening
Records identified through other sources (e.g. contacts with experts, searching bibliographies)
(n = 20)
Full-text records excluded based on exclusion criteria
(n = 15)
Included
Sources relevant for this review
(n = 63)

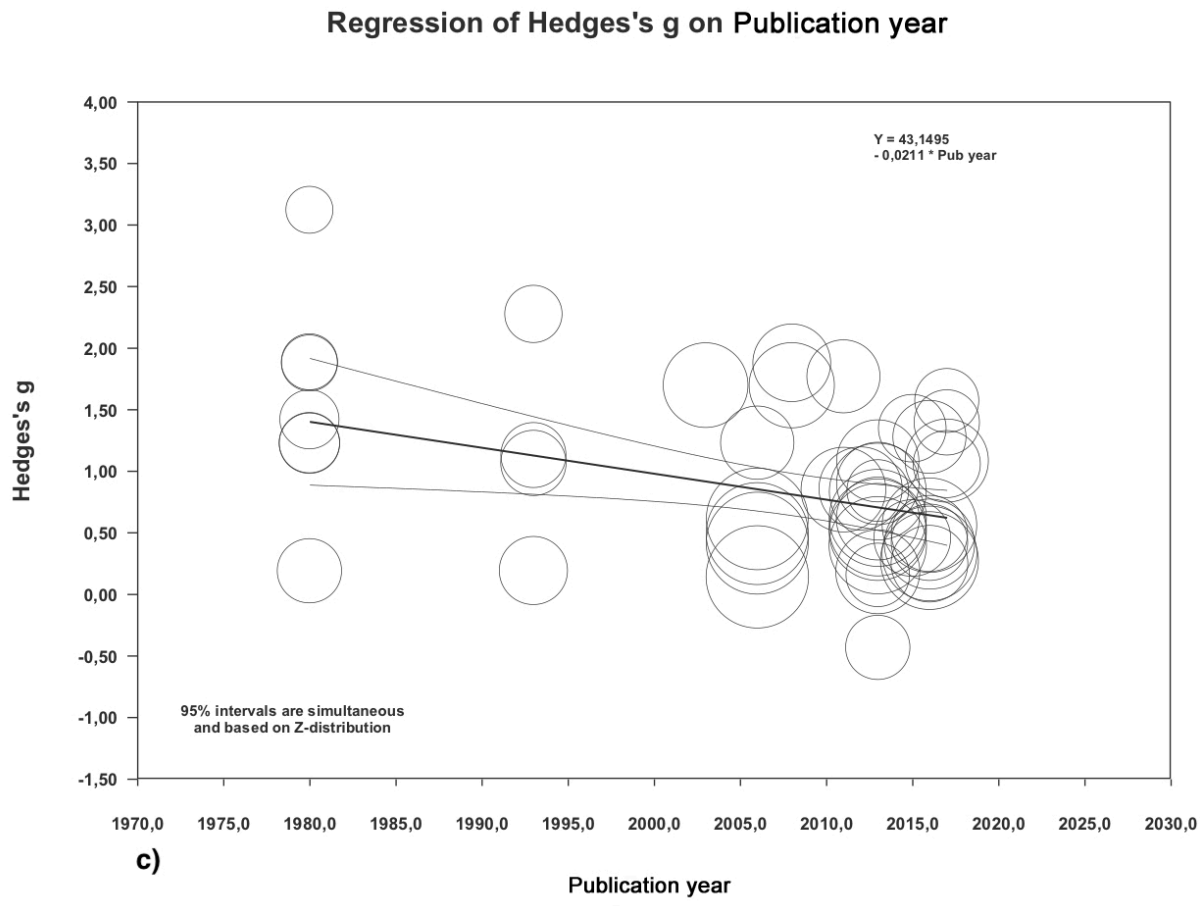

Study name
Intervention
Measurement
Hedges's g and 95% CI
Hedges's g
Lower limit
Upper limit
p-Value
Blackwell et al. (2006) PG Efficacy of Treatment Questionnaire 1,229 0,489 1,968 0,001
Brody et al. (2006) PG Expectations for Alcohol Use Score 0,490 0,285 0,696 0,000
Brody et al. (2006) PG Involved-Vigilant Parenting Score 0,139 -0,056 0,334 0,162
Brody et al. (2006) PG Racial Socialization Score 0,413 0,211 0,616 0,000
Brody et al. (2006) PG Sexual Communication Score 0,610 0,398 0,821 0,000
Crowell-Davis et al. (2003) PG Storm Phobia Assessment Score 1,696 1,159 2,233 0,000
Jang et al. (2012) PG e-Learning Multiple Choice Test 0,857 0,297 1,417 0,003
Lindgren et al. (2016) PG In Home Therapy Observation 0,271 -0,025 0,567 0,072
Lindgren et al. (2016) PG Telehealth Clinic Observation 0,406 -0,033 0,845 0,070
Lindgren et al. (2016) PG Telehealth Home Observation 0,330 -0,029 0,688 0,071
Lucyshyn et al. (2015) PG Number of Problem Behaviours 1,347 0,491 2,202 0,002
Minjarez-Boettcher et al. (2011) PG Pivotal Response Training Fidelity 1,767 1,020 2,514 0,000
Minjarez-Boettcher et al. (2011) PG Pivotal Response Training Utterances 0,848 0,313 1,383 0,002
Reitzel et al. (2013) PG Caregiver Strain Questionnaire 0,155 -0,787 1,098 0,747
Reitzel et al. (2013) PG Knowledge Questionnaire 0,840 -0,147 1,827 0,095
Reitzel et al. (2013) PG Sense of Competence Questionnaire -0,434 -1,364 0,496 0,360
Rostad et al. (2017) PG Number of Hazards 1,083 0,522 1,645 0,000
Rudy et al. (2017) PG Anxiety Disorder Interview 1,055 0,190 1,921 0,017
Rudy et al. (2017) PG Clinical Improvement Rating 1,572 0,641 2,503 0,001
Rudy et al. (2017) PG Pediatric Anxienty Rating 1,393 0,487 2,299 0,003
Schoenfelder et al. (2013) PG Depression Questionnaire 0,833 0,516 1,149 0,000
Schoenfelder et al. (2013) PG Grief Questionnaire 0,540 0,228 0,853 0,001
Schoenfelder et al. (2013) PG Learner Externalizing Questionnaire 0,504 0,193 0,816 0,002
Schoenfelder et al. (2013) PG Learner Internalizing Questionnaire 0,618 0,303 0,933 0,000
Schoenfelder et al. (2013) PG Positive Parenting Questionnaire 0,396 0,089 0,703 0,011
Pelham et al. (1980) PG Activity Scale WWP 3,120 1,696 4,544 0,000
Pelham et al. (1980) PG Aggressive-Conduct Questionnaire 1,886 0,752 3,020 0,001
Pelham et al. (1980) PG Count Correct Problems Completed 1,224 0,205 2,243 0,019
Pelham et al. (1980) PG Parent Command Observation 1,877 0,745 3,009 0,001
Pelham et al. (1980) PG Parent Praise Observation 0,189 -0,740 1,118 0,690
Pelham et al. (1980) PG Percentage On-Task Observation 1,418 0,369 2,467 0,008
Pelham et al. (1980) PG Problem Behaviour Rating 1,229 0,209 2,249 0,018
0,761 0,603 0,919 0,000
-4,00
-2,00
0,00
2,00
4,00
Favours Pre/Control
Favours Post/Treated


Study name
Intervention
Measurement
Hedges's g and 95% CI
Hedges's g
Lower limit
Upper limit
p-Value
Haydicky et al. (2015) OI Mindful Parenting Questionnaire 0,455 -0,220 1,130 0,186
Ilg et al. (2016) OI Behaviour Problems Questionnaire 0,491 -0,195 1,178 0,160
Ilg et al. (2016) OI French Parent Stress Index 0,247 -0,431 0,925 0,476
Ilg et al. (2016) OI Knowledge Questionnaire 1,276 0,532 2,020 0,001
Ilg et al. (2016) OI Quality of Life Rating 0,420 -0,263 1,103 0,228
Saunders et al. (2013) OI Positive Alternatives Observation 1,081 0,502 1,661 0,000
Saunders et al. (2013) OI Positive Guidance Observation 0,180 -0,367 0,727 0,518
Cottam et al. (2008) OI Problem Behaviour Rating 1,695 1,168 2,222 0,000
0,740 0,326 1,153 0,000
-4,00
-2,00
0,00
2,00
4,00
Favours Pre/Control
Favours Post/Treated


Study name
Hedges's g and 95% CI
Hedges's g
Lower limit
Upper limit
p-Value
Clark et al. (1993) 1,033 0,571 1,495 0,000
Blackwell et al. (2006) 1,229 0,489 1,968 0,001
Blackwell et al. (2016) 0,558 0,196 0,921 0,003
Brody et al. (2006) 0,403 0,301 0,505 0,000
Crowell-Davis et al. (2003) 1,696 1,159 2,233 0,000
Haydicky et al. (2015) 0,455 -0,220 1,130 0,186
Ilg et al. (2016) 0,580 0,232 0,928 0,001
Jang et al. (2012) 0,857 0,297 1,417 0,003
Lindgren et al. (2016) 0,318 0,116 0,521 0,002
Lucyshyn et al. (2015) 1,347 0,491 2,202 0,002
Minjarez-Boettcher et al. (2011) 1,159 0,725 1,594 0,000
Reitzel et al. (2013) 0,162 -0,388 0,712 0,564
Rostad et al. (2017) 1,083 0,522 1,645 0,000
Rudy et al. (2017) 1,327 0,808 1,847 0,000
Saunders et al. (2013) 0,678 0,395 0,961 0,000
Schoenfelder et al. (2013) 0,575 0,436 0,715 0,000
Pelham et al. (1980) 1,380 0,973 1,787 0,000
Cottam et al. (2008) 1,766 1,355 2,178 0,000
0,880 0,683 1,078 0,000
-1,50
0,00
1,50
3,00
Favours Pre/Control
Favours Post/Treated


Regression of Hedges's g on Learner species
Y = 0,6887
+ 0,5773 if Learner species = Dog
95% intervals are simultaneous
and based on Z-distribution
Hedges's g
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
a)
Human
Dog
Learner species


Regression of Hedges's g on Learner age
Y = 1,7768
- 1,0858 if Learner age = 1-11 years
- 1,3216 if Learner age = 12-18 years
- 0,7078 if Learner age = 2-24 months (dog)
- 0,6835 if Learner age = 2-8 years (dog)
95% intervals are simultaneous
and based on Z-distribution
Hedges's g
5,00
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
b)
n/a (dog)
1-11 years
12-18 years
2-24 months (dog)
2-8 years (dog)
Learner age


Regression of Hedges's g on Publication year
Y = 43,1495
- 0,0211 * Pub year
95% intervals are simultaneous
and based on Z-distribution
Hedges's g
Publication year
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
1970,0
1975,0
1980,0
1985,0
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1995,0
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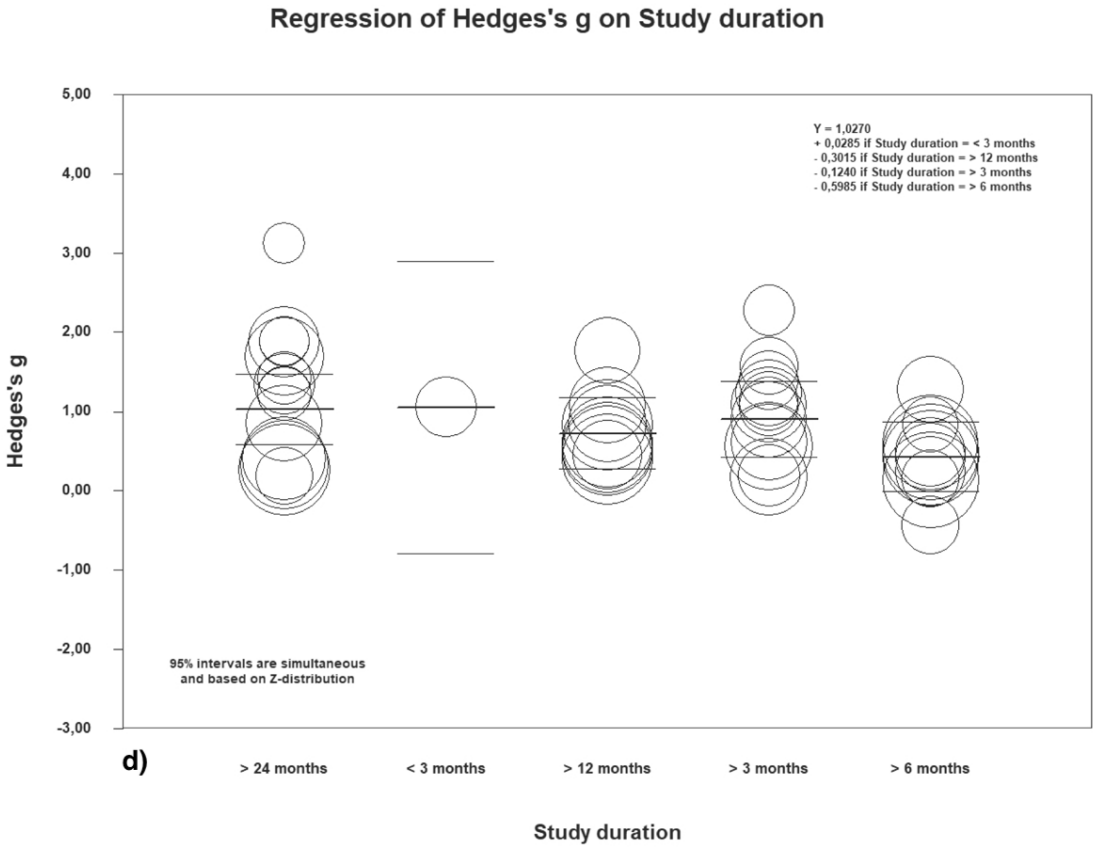
2005,0
2010,0
2015,0
2020,0
2025,0
2030,0

c)


Regression of Hedges's g on Study duration
Y = 1,0270
+ 0,0285 if Study duration = < 3 months
- 0,3015 if Study duration = > 12 months
- 0,1240 if Study duration = > 3 months
- 0,5985 if Study duration = > 6 months
95% intervals are simultaneous
and based on Z-distribution
Hedges's g
5,00
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
d)
> 24 months
< 3 months
> 12 months
> 3 months
> 6 months
Study duration


Funnel Plot of Standard Error by Hedges's g
Standard Error
0,0
0,2
0,4
0,6
0,8
-4
-3
-2
-1
0
1
2
3
4
Hedges's g

Figure captions

Figure 1. Flow diagram of the different stages during the selection process for identification of studies eligible for further (statistical) analysis (adapted after PRISMA guidelines - Liberati *et al*., 2009; Moher *et al.*, 2009).

Figure 2. Package (PG) forest plot and effect size statistics. Note. Measurement column shows how the dependent variables were measured (e.g. questionnaires or direct observations). The diamond-shaped data point at the bottom of the forest plot represents the summary effect size for all PGs.

Figure 3. Oral instruction/advice (OI) forest plot and effect size statistics. Note. Measurement column shows how the dependent variables were measured. The diamond-shaped data point at the bottom of the forest plot represents the summary effect size for all OI.

Figure 4. Effect size statistics and forest plot for all included studies. Note. The diamond-shaped data point at the bottom of the forest plot represents the overall effect size estimation across all studies.

Figure 5. Scatterplots of meta-regressions for statistically significant results: a) Learner species across all measures; b) Learner age across all measures; c) Years of publication for respective studies. The regression line shows that the average effect of studies in the total sample decreases; and d) Duration of research across measures.
Note. The bold lines represent the average effect for the respective covariate, while the thin lines represent lower and upper 95% CIs. The circles represent individual measures or studies, with smaller circles representing measures or studies with smaller standard errors.

Figure 6. Funnel plot showing the distribution of all included studies.